AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

JULY 1947

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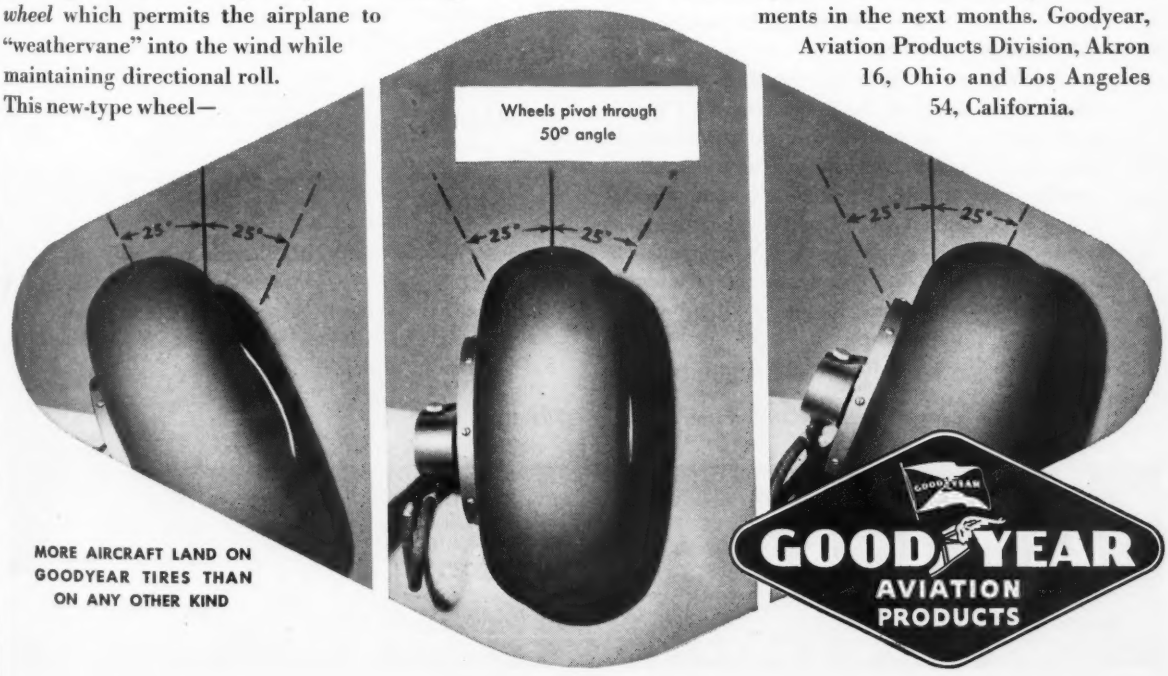

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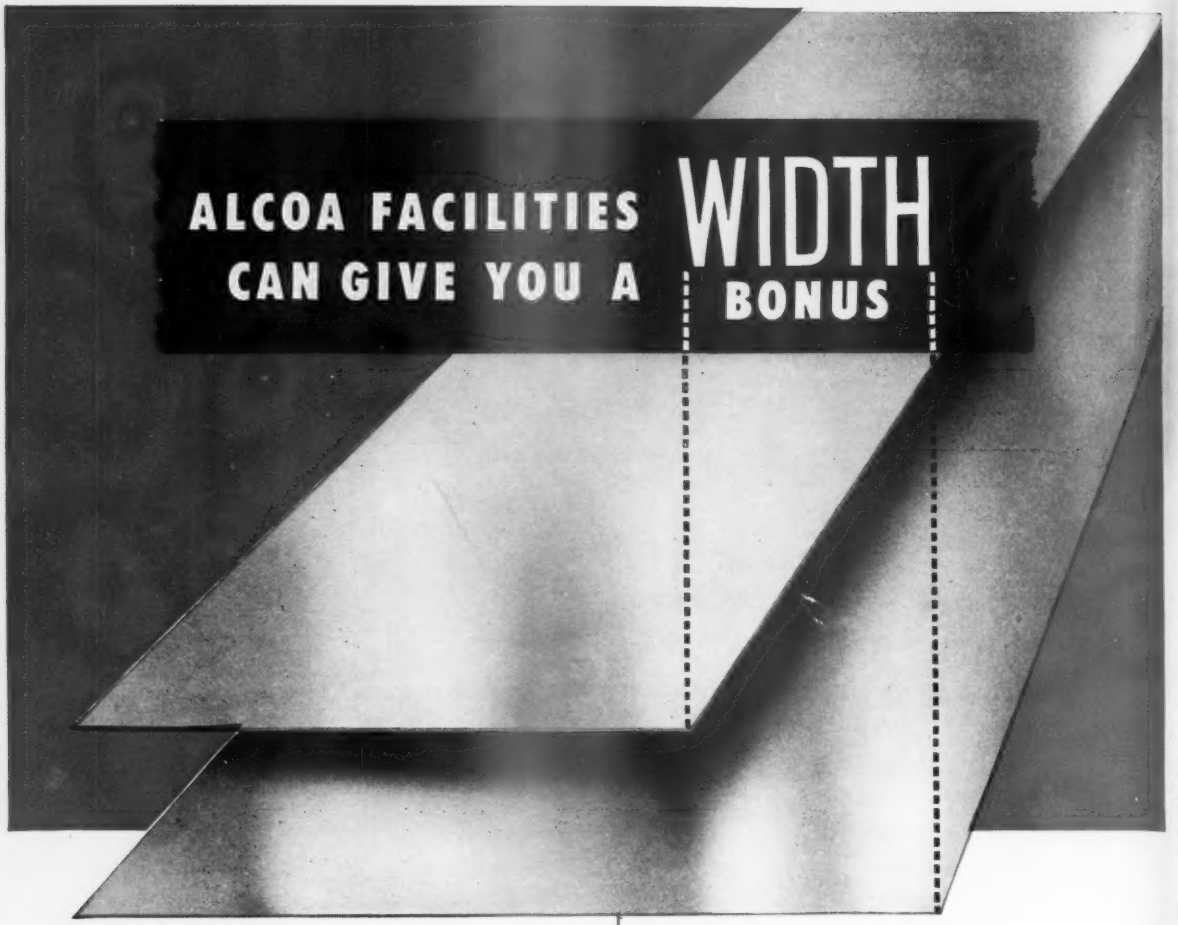

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Cover—The Hughes Flying Boat, as it nears completion in its graving dock at Long Beach, Calif.

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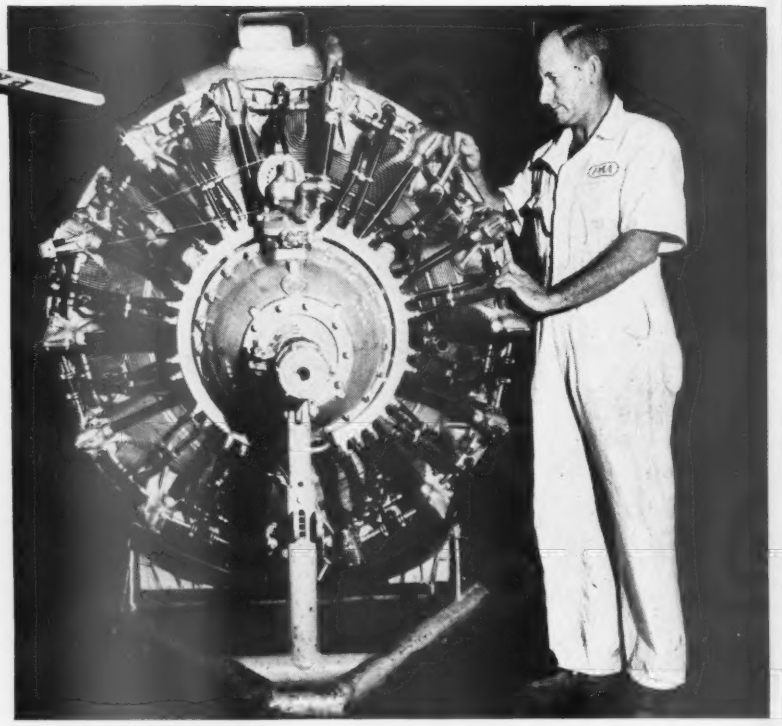
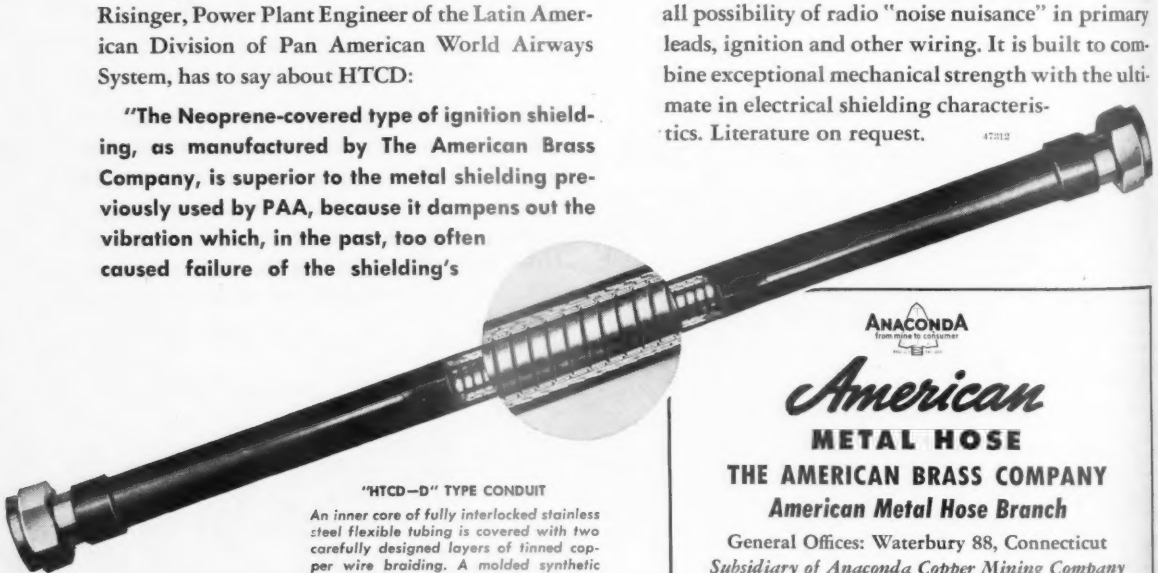


Pan American comments on AMERICAN SHIELDING CONDUIT

THIRTEEN LEADING AMERICAN, and many foreign, airlines have acclaimed American HTCD Electrical Shielding Conduit as the outstanding ignition shielding available today. Here is what Mr. B. W. Risinger, Power Plant Engineer of the Latin American Division of Pan American World Airways System, has to say about HTCD:

"The Neoprene-covered type of ignition shielding, as manufactured by The American Brass Company, is superior to the metal shielding previously used by PAA, because it dampens out the vibration which, in the past, too often caused failure of the shielding's waterproof quality. This new type of shielding tends to last three to four times as long as that formerly used."

American HTCD Shielding Conduit eliminates all possibility of radio "noise nuisance" in primary leads, ignition and other wiring. It is built to combine exceptional mechanical strength with the ultimate in electrical shielding characteristics. Literature on request. 47312



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I.A.S. News

A Record of People and Events of Interest to Institute Members

Plan 15th Anniversary Party at Annual Summer Meeting

Celebration of Institute's Founding in 1932 Is Scheduled; All Past-Presidents Invited to Attend

A SPECIAL BIRTHDAY PARTY celebrating the anniversary of the founding of the Institute of the Aeronautical Sciences 15 years ago has been added to current plans for the Annual Summer Meeting, August 7–8, at the Hotel Ambassador, Los Angeles. All Past-Presidents of the Institute, beginning with Dr. Jerome C. Hunsaker and ending with Arthur E. Raymond, have been invited to be present at the celebration to take place at the Dinner, August 8.

Under the guidance of Preston R. Bassett, President of the I.A.S., the Past-Presidents will be called upon to review briefly the Institute's outstanding services to the aviation industry during the years since its inception.

Although date of founding is October 15, 1932, the Annual Summer Meeting has been chosen as nearest major I.A.S. event at which members will be present to suitably commemorate the Institute's birthday.

At time of going to press, John N. Brown, Assistant Secretary of Navy for Air, an Honorary Member, had accepted an invitation to be guest speaker at the Dinner to be in the Main Ballroom of the Ambassador.

Meanwhile, plans for the 2-day program of technical sessions are assuming definite shape. Ten papers tentatively planned previously have been scheduled, at press time, covering the four sessions. These include:

- "High Speed Testing in Southern California Cooperative Wind Tunnel," Clark B. Millikan, Acting Director, Guggenheim Aeronautical Laboratory, and J. E. Smith and R. J. Bell, Guggenheim Aeronautical Laboratory, California Institute of Technology.
- "Instrumentation of Guided Missiles; Applications and Limitations," Lester G. Zuckerman, Equipment Design Engineer, Hughes Aircraft Company.
- "Full-Scale Free Flight Ballistic Measurements," L. A. Delsasso, Chief, Ballistic Measurements Laboratory; A. L. G. Bey, Chief, Electronic Measurements Branch; and D. Reuyl, Chief Optical Measurements Branch, Ballistic Measurements Laboratory, Ballistic Research Laboratories, Aberdeen Proving Ground.
- "The Bell XS-1 Transonic Research Airplane," Robert M. Stanley, Vice-President—Engineering, Bell Aircraft Corporation.
- "Analysis for Optimum Transport Airplane Configuration," Philip A. Coleman, Chief Aerodynamics Engineer, Lockheed Aircraft Corporation.
- "Parameters Affecting Aircraft Weights," William F. Ballhaus, Structures Engineer, El Segundo Division, Douglas Aircraft Company, Inc.
- "Trends in Aircraft and Engine Performance," M. U. Clauser, Mechanical and Equipment Section, Douglas Aircraft Company, Inc.
- "Operational Aerodynamics of High Speed Transport Aircraft," R. S. Shevell, Performance Engineer, Aerodynamics Group, Engineering Department, Douglas Aircraft Company, Inc.
- "A Method for Wind Tunnel Testing through the Transonic Range," John H. Weaver, Lockheed Aircraft Corporation.
- "Downwash and Sidewash Problems in Supersonic Wing Theory," Paco Lagerstrom, Assistant Professor in Aeronautics, California Institute of Technology.

"Gene" Root, Los Angeles Section Chairman, Host for Summer Meeting.

The four sessions among which the papers are divided will be chairmanned as follows: "Techniques of High Speed Model Testing"—Chairman A. E. Puckett; "Progress in High Speed Flight Research"—Chairman Smith J. DeFrance; "Design and Performance Trends"—Chairman A. E. Lombard; and "Powerplant and Aircraft Development"—Chairman A. E. Raymond.

John K. Northrop, President of Northrop Aircraft, Inc., will present his recent Wilbur Wright Memorial Lecture on "Development of the Flying Wing" in the session entitled "Powerplant and Aircraft Development."

I.A.S. Calendar

August 7–8, 1947	Annual Summer Meeting, Los Angeles, Calif.
September 2–6, 1947	Joint Meeting, Royal Aeronautical Society, London, England

Arthur E. Raymond *(second from left)*, Vice-President in Charge of Engineering, Douglas Aircraft Company, Inc., and 1946 President of I.A.S., at the 92nd Annual Commencement Exercises of Polytechnic Institute of Brooklyn at which he received an Honorary Degree of Doctor of Engineering. Degree was awarded by Charles E. Potts *(left)*, President of Polytechnic Corporation, and citation was read by Dr. Harry S. Rogers, President of Polytechnic Institute of Brooklyn *(center)*.

Arthur E. Raymond Honored

The Polytechnic Institute of Brooklyn conferred its honorary degree of Ph.D. for Engineering upon Arthur E. Raymond this past month. Mr. Raymond, Vice-President in Charge of Engineering, Douglas Aircraft Company, Inc., is a Fellow of the Institute of the Aeronautical Sciences and served as the Institute's President during 1946.

As guest of honor at a dinner given by the Corporation of the Polytechnic Institute on June 10, Mr. Raymond was introduced by Mr. Preston R. Bassett, who gave added praise of his accomplishments and contributions to the aeronautical engineering profession. Attending the dinner were approximately 85 other leaders in industry, finance, engineering, science, and education.

Stanley Named V-P Engineering of Bell Aircraft Corp.

Robert M. Stanley, an Associate Fellow of the Institute and the first American to fly a jet-propelled plane, has been named Vice-President of Engineering, Bell Aircraft Corporation, it was announced by Lawrence D. Bell, President.

Formerly Chief Engineer with supervision of all phases of engineering relating to military aircraft, Stanley joined Bell Aircraft in July, 1940. In 1941 he became Chief Test Pilot. He has been closely associated with Bell's work on jet propulsion since May, 1942, making the first flight on the twin-jet Bell fighter October 1, 1942. A Director and former Vice-President of the Soaring Society of America, Stanley set a soaring mark for gliders of 16,300 ft., and is a three-time member of the Caterpillar Club.

Van Zandt Joins Publishing Company

J. P. Van Zandt has resigned as Director of Aviation Research with the Brookings Institution to join American Aviation Publications, it was announced by Wayne W. Parrish. Van Zandt, Fellow of the Institute and internationally known aviation economist, has been elected a Vice-President in charge of company's new international division.

Three I.A.S. Members Elected to N.A.S.C. Steering Committee

Walter Cerny, Director of Engineering, Northrop Aircraft, Inc., and an Associate Fellow of the Institute; Tom Salter, Cessna Aircraft Company, and Walter Korff, Lockheed Aircraft Corporation, Members, have been elected to posts in the National Aircraft Standards Committee of the Aircraft Industries Association. Mr. Korff has been named Chairman of the Western Division, and all three are on the new five-man N.A.S.C. Steering Committee. Salter's election marks the first time in recent years that a personal aircraft representative has been a member of the top group responsible for standardization in the aircraft industry.

E. P. Warner Named First ICAO Council President

Dr. Edward P. Warner, Honorary Fellow of the Institute and former member of the Civil Aeronautics Board, was named President of International Civil Aviation Organization's first Council during its assembly in Montreal. Dr. Warner, who was one of the chief participants in guiding the international civil aviation body through its provisional stages, in his new position will supervise the permanent ICAO establishment which has its headquarters in Montreal.

A member of the U.S. delegation to the Chicago Conference of 1944, Dr. Warner was elected to the presidency of the Interim Council of the Provisional Civil Aviation Organization, predecessor to ICAO, when the council first met in August, 1945. During a distinguished career in aviation he designed the first wind tunnel at Langley Field in 1919–1920, was Professor of Aeronautical Engineering at Massachusetts Institute of Technology from 1920–1926, served as Assistant Secretary of Navy for Aeronautics, 1926–1929, and was appointed a member of the C.A.B. in 1939. In 1941 he was designated Vice-Chairman of that body by the President.

Edward P. Warner.

Lester D. Gardner . . . "for outstanding achievement in advancing aeronautics, particularly for his conception and organization of the Institute of the Aeronautical Sciences."

1947 GUGGENHEIM MEDALIST

The 1947 Daniel Guggenheim Medal given for notable achievements in the advancement of aeronautics has been awarded to Lester D. Gardner of New York. The selection of the recipient for this highest American aeronautical honor is made by a board of 21 members consisting of the former recipients of the medal and representatives of The American Society of Mechanical Engineers, the Society of Automotive Engineers, and the Institute of the Aeronautical Sciences. The medal and a certificate were awarded to Major Gardner "for outstanding achievements in advancing aeronautics, particularly for his conception and organization of the Institute of the Aeronautical Sciences." Other honors that have been received by Major Gardner are The Diploma of Honor and Gold Medal from the International League of Aviators, the honorary degree of Doctor of Laws from the Polytechnic Institute of Brooklyn, and he was the third American to be made an Honorary Fellow of the 80-year-old Royal Aeronautical Society of Great Britain. Some of the other recipients of the Daniel Guggenheim Medal have been Orville Wright, Glenn L. Martin, Donald W. Douglas, Juan T. Trippe, Lawrence D. Bell, and T. P. Wright.

Major Gardner was born in New York City and graduated from the Massachusetts Institute of Technology, after which he studied administrative law at Columbia University. He was the publisher and owner of the magazines *The Rubber Age* and *Aviation*, the latter the oldest aeronautical publication in the United States. He served in the Air Services in World War I and was on flying status when discharged as a Major in 1919. He has represented the United States at international aeronautical congresses at Rome and Washington. In 1932 he organized the Institute of the Aeronautical Sciences and was Chairman of its council and President of the Aeronautical Archives until his retirement.

Fairbanks General Manager of S. Fairchild and Associates

Appointment of Karl J. Fairbanks as General Manager of Sherman Fairchild and Associates, 30 Rockefeller Plaza, New York City, has been announced by the company. Formerly Acting Texas Manager of the Personal Planes Div., Fairchild Engine and Airplane Corporation in Dallas, Tex., Mr. Fairbanks resigned his position last January to join Sherman M. Fairchild in establishing the new firm.

Beginning with an appointment as an aeronautical engineer with the Government research laboratories under National Advisory Committee for Aeronautics at Langley Field, Fairbanks later joined Consolidated Aircraft Corporation in Buffalo where he spent several years designing and stressing airplanes. In 1930 he was Technical Assistant to the board of directors of Aviation Corporation. While a member of the New York University faculty, he served as an engineering consultant with Edo Aircraft Corporation, Long Island, N.Y., later joining Brewster Aeronautical Corporation, where he rose to head its Long Island City engineering department. In 1944 Fairbanks became Chief Engineer of the Development Division, Fairchild Engine and Airplane Corporation, and 2 years later was promoted to acting manager of the Personal Planes Division in Texas.

Mr. Fairbanks was elected an Associate Fellow of the Institute in 1945.

Gifts to the Institute Collections

Mr. and Mrs. Gordon Wightman added two prints, "Moyen Infallible de Diriger les Ballons" and "Allarme Générale des Habitants de Gonesse," to their previous generous gifts in memory of their son, Henry Wightman. Two loose-leaf volumes of its *Aerodynamics Data Sheets* and *Stressed Skin Data Sheets* were received from The Royal Aeronautical Society. John R. Cuneo sent a copy of his book, *The Air Weapon, 1914–1916*. The Cornell Aeronautical Laboratory, through the courtesy of Miss Elma T. Evans, added two translations to those previously given.

Notes taken by J. N. Ball, Jr., on six lectures by Dr. Theodore von Kármán on "Supersonic Aerodynamics" were received from the Chance Vought Aircraft Division of United Aircraft Corporation. Monographs dealing with aerial photography, and issues of *L'Aérophile* for 1942, 1943, and 1944 were received from André Charriou, adding to his previous gifts. Over 400 original German reports, including 119 *ZWB Forschungsberichte* and 22 *Untersuchungen und Mitteilungen*, 90 *Schriften* and 17 *Mitteilungen* of the Deutschen Akademie der Luftfahrtforschung, 49 *Technische Berichte*, and 61 *Berichte* of the Lilienthal-Gesellschaft für Luftfahrtforschung, and 1,500 German documents on microfilm, were added to those previously given by the Air Documents Division of the Air Matériel Command.

Dr. Alexander Klemin added 40 books to his previous generous gifts. Reproductions of three aeronautical sketches by Peter Herd were received from the Museum of the City of New York through the courtesy of Mrs. Bella C. Landauer. The Bureau of

Aeronautics of the Navy Department added paper and microfilm copies of reports to its previous gifts. Charles H. Colvin sent a *Biographical Memoir of Alexander Graham Bell.* The British Supply Office continued its previous gifts with copies of bibliographies and translations. Among additional donors were International Nickel Company, Inc., the Society of Automotive Engineers, Civil Aeronautics Administration, Civil Aeronautics Board, and the War Department.

War Department Award to Alexander Kartveli

A War Department Special Award to Alexander Kartveli, Fellow of the Institute, in appreciation for his service "in a position of trust and responsibility" during World War II, was presented by Major Gen. Charles B. Stone, III, Chief of Staff, Air Defense Command, last May.

Text of the Award, which was made at the Farmingdale plant of Republic Aviation Corporation in the presence of Major Gen. Robert W. Douglass, Jr., Commanding General, and Brig. Gen. Clifford C. Nutt, Chief of Staff, First Air Force, as well as company officials and employees, read as follows:

"The War Department expresses its appreciation for patriotic service in a position of trust and responsibility to Alexander M. Kartveli in recognition of your exceptional ability in aircraft design which made possible great increases in speed and range in fighter aircraft produced for the armed forces."

Corporate Member News

● **Aero Insurance Underwriters** sent Gloria W. Heath, ex-Wasp and member of A.I.U.'s safety engineering staff, to Bell Aircraft's helicopter mechanics school in Buffalo for a familiarization course.

● **American Airlines System's** Contract Air Cargo Division has closed its operations at St. Joseph, Mo.

● **Bell Aircraft Corporation** is turning out 25 pilots per month at its commercial helicopter pilots' school in Buffalo.

● **Douglas Aircraft Company, Inc.,** is acquiring 1,300,000 sq.ft. of hangars and shops, and 75,000 sq.ft. of office space of the Long Beach plant from the War Assets Administration for $7,810,413. Included in transaction are 141 acres of plant and real estate property, 45 acres of parking lot.

● **The B. F. Goodrich Company's** new research center near Brecksville, Ohio, is about 50 per cent completed. Ground was broken in January, 1946.

● **McDonnell Aircraft Corporation** has signed 5-year lease with city of St. Louis on a portion of former Curtiss-Wright plant at Lambert-St. Louis Municipal Airport. Of 1,500,000 sq.ft. total plant area, McDonnell is leasing 1,100,000 sq.ft., remainder to be at disposal of the city to be let to air lines.

● **Minneapolis-Honeywell Regulator Company** has moved its Chicago regional office to new location at 351 East Ohio Street where it occupies entire top floor, along with Brown Instrument Company, Honeywell's industrial division.

● **North American Aviation, Inc.,** has announced operation of first supersonic wind tunnel for guided missile research. Tests at speed of 1,850 m.p.h. have been made. Company also plans operation of former Pacific Aviation plant as an additional machine shop.

● **Northwest Airlines** received National Safety Council's Annual Safety Award for having flown without a fatality in 1946.

● **Piper Aircraft Corporation** is completing a 10 per cent expansion of its main Lock Haven plant facilities.

● **Socony-Vacuum Oil Company, Inc.,** has reorganized its aviation department to place greater emphasis on field representative activities. Aviation field organizations have been built and trained to carry out bulk of marketing efforts in commercial and private flying in a move designed to promote closer working relations between company and clients.

● **Trans World Airline** received special National Safety Council Distinguished Service Safety Award for having flown 1,441,149,905 passenger-miles without a fatality during scheduled operations from December 1, 1944, to December 27, 1946.

● **United Air Lines, Inc.,** has established new facilities for training company stewardesses at a "dude ranch" school connected with its systemwide training center at Cheyenne, Wyo. Estimating a need for 350–400 new stewardesses this year, United has set up living quarters and classrooms to give girls complete training course.

Alexander M. Kartveli (*center*) receiving special War Department citation at Republic Aviation Corporation plant. Participating in presentation ceremony are (*left to right*): Major Gen. Charles B. Stone, Deputy Commander and Chief of Staff, Air Defense Command; Major Gen. Robert W. Douglass, Jr., Commanding General, First Air Force; Brig. Gen. Clifford C. Nutt, Chief of Staff, First Air Force; and Mundy I. Peale, President, Republic Aviation Corporation.

● **Western Air Lines, Inc.,** has moved its maintenance and overhaul departments from Lockheed Air Terminal to Los Angeles Municipal Airport at Mines Field.

● **Wright Aeronautical Corporation** has transferred its West Coast office, known as Wright Aero Ltd., from 434 North Le Brea Ave., Los Angeles, to Grand Central Air Terminal, 1314 Air Way, Glendale 1, Calif. Mailing address is P.O. Box 1351, Glendale 5.

Sections and Branches

Boston Section

W. O. Meckley, *Secretary*

March 4 meeting of the Section was held at Massachusetts Institute of Technology where members heard John H. Conover, Chief Observer of Blue Hill Meteorological Observatory, Harvard University, present a paper on "Cloud Studies." Slides were shown illustrating the analysis of synoptic cloud observations from the entire country and the normal distribution of cloud formations around storm centers. C. F. Taylor, Chairman, presided.

▶ **Dr. von Kármán Speaks**—At May 14 meeting, Theodore von Kármán, California Institute of Technology, reviewed the fundamentals of supersonic aerodynamics and outlined problems confronting aerodynamicists which differ from problems encountered in subsonic range.

Dr. von Kármán was heard by approximately 110 persons in attendance at the Thomson Club in Nahant. He was introduced by Dr. R. von Mises, Harvard University. Problems of transonic flight with special emphasis on formation of shock waves and their interaction with the boundary layer were discussed. Use of sweepback to combat wave resistance and some practical aerodynamic designs for supersonic flow were outlined.

Following Dr. von Kármán's talk, the meeting was given over to a discussion period.

Dayton Section

E. W. Robischon, *Secretary*

Second meeting of the Section, held May 29 at the Engineers Club in Dayton, featured a Power Plant Symposium prepared by members of the N.A.C.A., Cleveland Laboratories. Approximately 250 members attended.

Opening the technical session, Chairman A. A. Arnhym (Colonel, U.S. Army Air Corps) announced the award of a contract to the I.A.S. for preparation of the Standard Aeronautical Index. Leslie E. Neville, Director of the Index project, was introduced and commented on the organization of the S.A.I.

The session then was turned over to Dr. A. M. Rothrock, Chief of Research of the Aircraft Engine Research Laboratory, N.A.C.A., Cleveland, who introduced the symposium speakers.

Papers presented were:

▶ **Compound Engine**—E. J. Manganiello, Chief, Thermodynamics Branch, Fuels and Thermodynamics Research Div.

▶ **Turbine-Propeller Engine**—J. C. Sanders, Chief, Engine Performance Branch, Engine Performance & Materials Research Div.

▶ **Turbojet Engine**—N. D. Sanders, Chief, Experimental Analysis Panel, Wind Tunnel and Flight Div.

▶ **Turbo-Ram-Jet Engine**—B. T. Lundin, Head, Jet Propulsion Research Section, Thermodynamics Branch, Fuels and Thermodynamics Research Div.

▶ **Ram-Jet Engine**—G. F. Kinghorn, Assistant Head, Engineering Section, Flight Branch, Wind Tunnel and Flight Div.

▶ **Rocket Engine**—E. Bernardo, Head, Rocket Section, Combustion Branch, Fuels and Thermodynamics Research Div.

Dr. Rothrock then summarized the comparison of the various power plants.

In closing the meeting, Colonel Arnhym announced that John K. Northrop, President, Northrop Aircraft, Inc., would present a paper outlining flying wing development at a future meeting.

Detroit Section

Robert Dale, *Secretary*

Held at the Rackham Memorial Bldg., May 7 meeting was opened by Chairman T. N. Kelly with a few general announcements. Newly elected officers of the Section were presented to the members in attendance: Chairman, Prof. Wilbur C. Nelson, University of Michigan; Vice-Chairman, Robert Dale, Aero Mechanics School, Detroit; Secretary, Lawrence Patrick, Wayne University; Treasurer, Henry H. Kerr, U.S. Rubber Company, Detroit. Area Council members: Peter Altman, David Borden, Gordon Page, Floyd Evans, George H. Tweney, John Squires, Arthur Locke, and Thomas N. Kelly.

▶ **Experimental Aerodynamics**—Featured speaker of the meeting was Dr. Arnold M. Kuethe, Professor of Aeronautics, University of Michigan, who spoke on "Experimental Aerodynamics." His talk was illustrated by slides showing various types of wind tunnels used for both slow- and high-speed tests. Some methods of using water tunnels also were discussed, and methods of boundary layer testing and expected results for various sections were pointed out. In addition, Dr. Kuethe made some comments on supersonic flow and shock waves.

A film of free flight ram-jet tests was shown and the test instrumentation used was discussed.

Hagerstown Section

George I. Hackenberger, Jr., *Secretary*

The April 30 meeting of the Section, held at Washington County Museum of Fine Arts, was devoted to the showing of four technical films: *Deicer Systems for Aircraft; Magnesium in Aircraft; Radio Receivers;* and *Physiology of High Altitude Flight.* A discussion followed each film.

▶ **Nuclear Energy**—At the May 21 meeting, also held at the Museum, Dr. Carl Rollinson, Professor of Radio-Chemistry, University of Maryland, presented a paper on "Engineering Uses of Nuclear Energy." Drawing a sharp distinction between the uncontrolled release of nuclear energy as a military weapon, and its controlled release as a power source, Dr. Rollinson stressed the fact that from an engineering standpoint the atomic pile is merely another form of heat engine. Major distinction, he said, is that heat is produced without combustion, and oxygen therefore is unnecessary.

▶ **Columbia River Heated**—In his paper Dr. Rollinson explained the construction of an atomic pile, the action of its parts, and control methods. In discussing engineering applications of nuclear energy, it was pointed out that the pile is an "all or nothing" proposition, and that quantitative control below a certain minimum energy level is impossible. Fact that this energy level is high was brought home by citing instance of the Hanford, Wash., plant which

They wrapped up a Jet plane insulation problem

J-M Thermoflex blanket reinforced with Inconel mesh being fitted around engine cone of jet plane.

Despite a blazing 1400° F. inside, structural members remain strong and safe... with the help of a fine wire mesh

Jet plane designers were faced with an insulation problem.

Supporting members of these planes had to be protected from the destructive heat radiated by the engine cones and tail pipes.

Proper blanket insulation was the answer. But what kind of blanket would have enough backbone to hold the insulating material in place at 1400° F.?

To this, Johns-Manville offered a solution . . . Inconel mesh.*

This tough, flexible material, woven from .0045" or .006" Inconel wire shows excellent strength at elevated temperatures. In J-M's *Thermoflex* blanket, the asbestos insulation is sandwiched securely between layers of Inconel mesh.

Result: The 1400° F. heat in the engine cone was *kept* there. Structural members remain strong and safe.

Insulation blankets are only one application of Inconel in jet planes. Others include the toughest possible high-temperature jobs . . . in the engine combustion chambers themselves.

Johns-Manville also uses Inconel for their high-temperature exhaust stack packing. Inconel is specified by aeronautical engineers for cabin heating boilers, exhaust systems, heat exchanges, de-icing equipment and other applications where "musts" include high hot strength, corrosion resistance, ductility, resistance to progressive oxidation.

Showing both sides of the J-M Thermoflex blanket. In addition to being reinforced with Inconel mesh, this blanket is tufted with Inconel buttons and tie wire and its edges are bound with Inconel and Monel wire cloth.

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heated the Columbia River making it 2° warmer downstream.

It was shown that a closed system for the heat-transferring agent through the nuclear power plant was always necessary, to avoid contamination of engine and surroundings by radioactivity.

During discussion following his talk, Dr. Rollinson exhibited a sample of radioactive sintered sand taken from the Alamogordo Desert site of first atomic bomb test, also a slide picture of the sand taken by its own radioactivity.

Philadelphia Section

Seymour Gottlieb, *Secretary*

Acclaimed as one of the finest held by the Section, the meeting of May 20 at the Engineers Club heard Dr. J. G. Coffin's discussion of supersonics, saw films on the *Bell Helicopter*, and the Navy's *Aerology*, showing formation of storms and other phenomena. In addition, the Nominating Committee presented the slate of candidates put up for election, to be voted upon by mailed ballot.

Dr. Coffin, a Ph.D. in mathematical physics of Clark University, retired as Technical Director in charge of development of General Baking Company in 1941 following a distinguished scientific career. World War II brought him back to aviation with Fleetwings, where he has been engaged in problems of subsonic and supersonic flow.

▸ **Shock Wave Theory**—Dr. Coffin's paper, of which he distributed preprints, was an introduction to shock wave theory, and his simplified presentation enabled all to comprehend the subject. Opening chapter of the paper stressed the importance of temperature rather than pressure and density as a primary variable in the thermodynamics of compressible flow, both sub- and supersonic. Charts were shown giving the relations before and after shock up to Mach Number 2.

▸ **Officers Elected**—Results of balloting on candidates selected were: Chairman, H. Russell Young, Baldwin Locomotive Works; Vice-Chairman, Comdr. Paul J. Burr, U.S.N., Supt., Aero. Materials Lab., Naval Air Experimental Station; Secretary, John Rogers, Supt. of Metlab Company; Treasurer, Robert L. Lichten, Transcendental Aircraft Company. Five members of the Area Council elected were: Ralph S. Barnaby, Frank Tatnall, Carl De Ganahl, John S. Kean, and Dr. Michael Watter. Carl De Ganahl also was elected to the Nominating Committee for Area Counselors.

San Diego Section

William B. Barkley, *Secretary*

Meeting April 10 at the Hotel San Diego, the Section, chairmanned by R. B. Johnston, heard a paper, "Flight Testing of Guided Missiles," by Harold K. Cheney, Chief Flight Test Engineer, Development Engineering, Consolidated Vultee Aircraft Corporation, Vultee Field.

▸ **Testing Guided Missiles**—Test procedures and the general type of equipment and instrumentation used to record data in experiments on guided missiles were described. Because such missiles are pilotless, a vast amount of work is being done in designing and perfecting instruments able to measure and record adequately the rapidly changing conditions under which most guided missiles operate, Cheney said. Much emphasis is placed upon analysis of data from all sources in order to obtain as true a picture as possible.

A discussion period followed presentation of the paper.

Seattle Section

Gene B. Williams, *Secretary*

The May 14 Section meeting, which was held in the Chamber of Commerce Building and presided over by K. J. McLean, Vice-Chairman, heard Myron Tribus of the University of California at Los Angeles, and E. E. Nelson, Chief Test Pilot, Aerojet Engineering Corporation.

▸ **Anti-Icing Research Progress**—Mr. Tribus traced the progress of wartime research in aircraft anti-icing with special emphasis placed upon establishment of parameters by which icing conditions could be measured. Size of water particles, distribution of various sizes of particles within a given air volume, and frequency of occurrence of water particles all contribute to overall severity of icing.

▸ **Jato Applications**—Mr. Nelson discussed various applications of Jato to air transport which already had proved feasible. Colored motion pictures of Jato used on DC-3 and DC-4 aircraft graphically portrayed the extraordinary improvement in aircraft performance made possible through Jato. Economic considerations preclude use of Jato as standard operating procedure for commercial planes, but these same considerations demand use of Jato as an emergency procedure to prevent crashes resulting from power failure during take-off, Nelson said.

Washington Section

Katharine Stinson, *Secretary*

Melvin N. Gough of National Advisory Committee for Aeronautics spoke at the Section's May 14 meeting in U.S. Chamber of Commerce Building on "Establishment of Handling Qualities for Aircraft."

▸ **N.A.C.A. Work**—Illustrating his lecture with numerous slides, Mr. Gough discussed the work being done by N.A.C.A., particularly as to instrumentation, in determining the handling characteristics of various aircraft types. Presiding at the meeting was Chairman R. E. Littell.

On May 21 approximately 25 members of the Section visited the David Taylor Model Basin at Carderock, Md.

University of Alabama

Second meeting of the spring quarter, chairmanned by Ross B. Robinson, heard J. B. Karl, owner of Dixie Air, Inc., and Secretary of Ozark Airlines, on requirements of plane design for personal and feeder-line aircraft. Listing the disadvantages of modern planes which might be corrected by the designer, Karl gave as the ABC's of airplane design: Accessibility, Beauty, Comfort, Diversified Use, and Efficiency. He stressed the contention that the light plane must be designed to the woman's taste. Karl also stated that there is no really good plane now in use as a feeder liner.

Alabama Polytechnic Institute

Two April meetings were held, on the 1st and 21st. On the 1st Professor G. H. Backer spoke on "Flight Testing of the FD (Partial)." At the second meeting, C. W. Garrett spoke on "Salaries in the Chance Vought Company." Presiding officer on each occasion was Wilmer H. Reed.

A. H. Kelly and E. P. Bass were elected as Alternate Representatives, and A. J. Collins as Representative, to the local Engineers Council.

At the May 27 meeting W. G. Rhodes discussed "The Brodie Device." Plans were made for the election of officers at the beginning of the summer quarter.

Polytechnic Institute of Brooklyn

At the April 24 meeting, following a brief introduction by Prof. N. J. Hoff, Faculty Adviser of the Branch, floor was given to Dr. R. S. Levy, Republic Aviation Corporation, who spoke on

"Problems in Landing Gear Design for High-Speed, Thin-Wing Aircraft."

Dr. Levy began his discussion with a summary of the history of landing gear development. Illustrating his talk with diagrams and drawings, he pointed out that because of the thin wings of high-speed aircraft, the available space into which landing gear may be retracted is considerably reduced.

Major John L. Martin, Polytechnic Institute of Brooklyn student, gave a talk on "Engineering Problems of the B-29" at the April 29 meeting. Major Martin, who had been associated with the B-29 during A.A.F. testing operations, began with a summary of the history of its development. He outlined problems of engine cooling, rudder structure, landing gear mechanism and carburetor design, indicating the solutions.

Election of officers, preceding Martin's talk, resulted as follows: Hrant H. Yousoufian, Chairman; Arthur W. Rogers, Vice-Chairman; Ann E. Gunsolus, Secretary; and Joseph Snitkoff, Treasurer.

Meetings were presided over by Glenford J. Wennagel, President.

Cornell University

At meeting at the Graduate School of Aeronautical Engineering May 14, an election of officers was held, Prof. J. M. Wild, Faculty Adviser, in the chair. Results were: R. H. Bray, Chairman; W. S. Miller, Vice-Chairman; R. E. Drumm, Secretary-Treasurer.

Following the business meeting, Dr. William R. Sears, Director, Graduate School of Aeronautical Engineering, spoke on "Some Engineering Problems in Tailless Airplanes." Formerly Chief of Aerodynamics, Northrop Aircraft, Inc., Dr. Sears was responsible for many aerodynamic features of a number of tailless designs.

University of Illinois

Two films, *FR-1 Fireball* and *B-29's over Dixie*, were shown at the May 7 meeting, following which election of officers for the summer semester took place.

Distinguishing features of Navy's new prop-jet fighter, together with its flight characteristics, were shown in technicolor. Part of a newsreel in the film showed the first squadron equipped with Fireballs. *B-29's over Dixie* is a film of Bell Aircraft's Georgia plant, which produced Superforts during the late war.

Branch officers elected were John. R. McGuire, Chairman; Louis S. Glover, Vice-Chairman; and Paul L. Klevatt, Secretary-Treasurer. A. Donald Swanson, Chairman, presided.

University of Michigan

John Lekas, President, Lekas Manufacturing Company, Ann Arbor, was the speaker at the May 9 meeting presided over by M. P. Murphy, Chairman. On the subject "Radio Aids to Aeronautical Research," Mr. Lekas gave an enlightening talk on problems connected with obtaining data on rocket flights and their solutions. He illustrated his lecture with slides showing projects on which he has worked.

Final arrangements for the dedication ceremony of Willow Run Airport as U. of M. property, and a report on progress of the I.A.S. display for the Michigan Air Show were made. In addition, arrangements for the Branch's Biannual Picnic were concluded.

University of Minnesota

Main event of the May 8 meeting at Coffman Memorial Union was the talk by Maurice Tucker, N.A.C.A., who spoke on "Compressibility and Its Effects." Outlining the problems concerning compressibility which had arisen at N.A.C.A., and methods used to solve them, Tucker also described some equations used in the work of constructing and testing supersonic wind tunnels. He detailed the immense power requirements for such wind tunnels, as well as other structural problems.

New officers for the coming year are: Louis F. Heilig, Chairman; Frank P. Nelson, Vice-Chairman; Harry T. Swanson, Secretary; Donald C. Knutson, Treasurer; and David B. Benepe, Publicity Chairman.

Final meeting of the session was the Annual Aero Picnic held the last of May.

Ohio State University

At meeting May 20 at Mendenhall Laboratory, members heard Tex Holt, Assistant Chief Flight Engineer, Curtiss-Wright Corporation, on the subject of "Flight-Test Engineering in Industry." Giving some background of flight-test engineering as a new branch of the aircraft industry, Holt described briefly the organization of flight-test engineering departments as conducted in most firms and mentioned some of the qualities he thought important in flight-test engineers.

Parks College of Aeronautical Technology

On May 15, P.C.A.T. Branch met in the Assembly Hall to hear Richard Dean, Student Branch member, read the paper by Hugh de Haven on "Greater Safety in Personal Aircraft." Methods of improving aircraft design from a safety standpoint were treated in the paper. Slides illustrating typical and unusual accidents were analyzed and discussed by the members.

Purdue University

Purdue Branch meeting in the Physics Building May 20 under chairmanship of Robert E. Sawyer, heard J. M. Whitmore, Head, Electronics and Vibrations Department, Allison Div., General Motors Corporation, speak on "Special Instruments and Their Aid to Engine Problems." Whitmore illustrated his talk with slides showing some of the special instruments.

Stanford University

"Problems of High-Speed Flight" was the topic of Graduate Students Harold Walker and John Spieiter at Stanford's May 13 Branch session, the last meeting of the year.

Concepts of airflow around the wing for transonic and supersonic speed ranges were discussed by Walker, who also described speed and manner in which shock waves were developed, and manner in which these shock waves affected streamlined flow. Spieiter discussed problems of lateral control and aileron flutter occurring at transonic speeds.

Syracuse University

Speaker at Syracuse Branch's third meeting, April 29, was Prof. Leslie R. Parkinson, Head of the Aeronautical Engineering Department, Syracuse University. Professor Parkinson discussed the future of the aeronautical engineering department at Syracuse, which is to be located at recently acquired General Electric surplus war plant on Thomson Rd. The department would move to new quarters directly as one-and-a-quarter-million dollar test house is available.

Main drawback is the great expense involved. Professor Parkinson estimated that 1,000 students would be required to make up the amount. New laboratory will be used for testing jet units and dynamometer equipment. A propeller test stand will be included. Three wind tunnels, a

structural test building, auditorium, and basketball court are planned.

At the fourth meeting, May 13, officers for the next semester were voted upon. Elected were Prof. L. R. Parkinson, Honorary Chairman; Elton Bischoff, Chairman; William Etherington, Vice-Chairman; Patricia Shaver, Secretary; and Edwin J. Jackso, Treasurer. Members also approved the proposed changes in the By-laws.

Virginia Polytechnic Institute

A short film, *Silent Wings*, obtained from Elmira Soaring Corporation, Elmira, was shown at the Branch's May 5 meeting. D. Morton Bland, President, presided.

On May 19, following the film, *Jet Propulsion*, plans were discussed for the proposed trip to Langley Field, and new officers were elected. J. L. Saffell was named Chairman; Joseph E. Montalbano, Vice-Chairman; William F. Seymour, Treasurer, and Henry W. Jarrett, Jr., Secretary. The meeting concluded with a showing of the film, *Working on Air*.

University of Washington

Under Chairman Raymond B. Oliver, the meeting of May 6 was held in Guggenheim Hall to hear John Steiner, Aerodynamics Project Engineer, Boeing Aircraft Company, on "C.A.A. Licensing of Commercial Aircraft." Steiner first explained organization of the Civil Aeronautics Authority. He then enumerated steps involved in obtaining a license for a new commercial plane. The trend toward more stringent regulations for new designs was discussed. The speaker emphasized that C.A.A. testing is a relatively costly process.

News of Members

Joel William Alldredge is now Jr. Engineer—Structures, Curtiss-Wright Corporation.

John McComb Allison has been appointed Acting Head of the Propulsion Laboratory, U.S. Naval Air Missile Test Center, Pt. Mugu, Calif. Before returning to inactive duty, he served with the rank of Commander as project officer for four-engined landplanes in Patrol Plane Branch, BuAer, Washington, D.C.

Warren Edward Anderson, formerly Jr. Engineer (Structural Test), Boeing Aircraft Company, has been appointed Aeronautical Engineer, Ames Aeronautical Laboratory, N.A.C.A.

Henry Frick Andrew, who has been Detail Engineer—Stress, Boeing Airplane Company, has joined McDonnell Aircraft Corporation as Assistant Stress Analyst.

Arthur M. Ariessohn is Sr. Aerodynamicist, Special Projects Dept., M. W. Kellogg Company. He formerly was Assistant Project Engineer with Edo Aircraft Corporation.

Allan Ashley Barrie, now Operations Manager, California-Eastern Airways, previously had been with the consulting firm of Alvin P. Adams Associates.

Wellwood E. Beall, Vice-President in Charge of Engineering and Sales, Boeing Aircraft Company, was re-elected to that post. He is a Fellow of I.A.S.

Edward Patterson Bentley is Vice-President, Instrument Development Laboratories, Inc. Formerly Research Associate, Aeronautical Dept., Massachusetts Institute of Technology, he served as Lt. (j.g.), Navy Bureau of Ordnance.

Herbert Berman has been made Project Engineer, Avion Instrument Corporation. Prior to service in the A.A.F., he had been with Chance Vought Aircraft Div., United Aircraft Corporation, as Aeronautical Engineer.

Robert W. Blake is in the Engineering Dept., Pan American Airways. He had served as an Ensign in the Navy.

John Shepard Bogen is President of Engineering Research & Development Company. He formerly was Director of the Automotive & Aircraft Dept., Universal Oil Products Company.

Walter John Boice, previously Design Engineer, Stinson Div., Consolidated Vultee Aircraft Corporation, is now self-employed.

Henry William Bollinger, now Assistant Designer, McDonnell Aircraft Corporation, formerly was Engineer—Power Plants Maintenance, Pan American-Grace Airways.

Hugh Boyd, Design Engineer with Pathe Industries, Inc., had served in the Navy as Ensign. Previously he was Research Engineer, Goodyear Aircraft Corporation.

James Henry Brewster resigned as Jr. Aeronautical Engineer (Research), United Aircraft Corporation, to become Assistant Director of Development, Fairchild Engine and Airplane Corporation.

Sidney Leon Britton is Design Engineer, Gas Turbine Engineering Div., A. V. Roe Canada, Ltd., following service with the Royal Canadian Navy as Squadron Engineer.

Louis Bruchiss, Editor of *Air Tech and Aerosphere*, has been elected a Director of the American Rocket Society, Inc., for an interim term ending December, 1947. He is an Associate Fellow of the Institute.

Raymond Kasper Bucher, now Flight Test Data Analyst, McDonnell Aircraft Corporation, had been with Pan American-Grace Airways as Maintenance Engineer.

Harold Henry Budds, formerly Vice-President and General Manager, Ranger Aircraft Engines Div., Fairchild Engine and Airplane Corporation, is President of Budds Aero Castings.

Walter Kenneth Bullivant is Aerodynamicist with Link Aviation, Inc. He resigned as Flight Test Analyst, Consolidated Vultee Aircraft Corporation (Fort Worth Div.).

Harry Burdett was elected a Director of the American Rocket Society, Inc., for an interim term ending December, 1947.

John Joseph Burns, Jr., now is with Structures Dept., Fairchild Engine and Airplane Corporation. Prior to service with the A.A.F., he had been Design Engineer, Bell Aircraft, and Structural Design Engineer and Stress Analyst, Cessna Aircraft Company.

Jorge Carnicero has been named Vice-President, Air Carrier Service Corporation. He had been Technical Representative of Flotea Mercante Argentina in the United States.

Thomas Francis Carroll, Jr., resigned as Engineer—Flight Test Section, Allison Div., General Motors Corporation, to go into business for himself.

Thomas Banks Carvey, Jr., is now Engineer, Aerophysics Laboratory, Rocket Propulsion Systems, North American Aviation, Inc. One-time Aerodynamicist with Globe Aircraft Corporation, he served in the Navy as Ensign.

Joseph Louis Cipriani is Flight Test Engineer, Aircraft Service Corporation.

Martyn Victor Clarke resigned as Sr. Stress Analyst, North American Aviation, Inc., to join The Glenn L. Martin Company as Stress Analyst. Formerly he had been Engineer, Douglas Aircraft Company, and Stress Analyst with Republic Aviation Corporation.

Eugene Oscar Clay has resigned as Chief Designer, Culver Aircraft Corporation to become Design Engineer, Ames Aeronautical Laboratory, N.A.C.A.

George Coleman is Mechanical Engineer with Chicago Pump Company.

Capt. Howard M. Cone has become the "royal" commander of Pan American World Airways' trans-Atlantic Clippers,

Capt. Howard M. Cone.

having flown several crowned heads of Europe and Egypt, in addition to the late President Franklin D. Roosevelt.

James Kiernan Cosgrove, formerly Engineer, Republic Aviation Corporation, is Inspector, C.A.A.

Thomas George Cribb is acting as Assistant to the Supervisor of Survey, Aircraft Div., Canadian Car & Foundry Company, Ltd. (St. Laurent plant). He had been Design Standards Engineer, Canadair Ltd.

Henry Lincoln Daly, Chief Weight Engineer with Columbia Aircraft Corporation, resigned to join Consolidated Vultee Aircraft Corporation as Weight Control Engineer, Development Engineering Group.

Jehangir C. Dastur, formerly Ground Engineer, Bombay Flying Club Ltd., India, now is Engine Maintenance Inspector, Air Services of India Ltd.

Robert Earl DeLand is Sr. Stress Analyst, The Glenn L. Martin Company. He had been with Curtiss-Wright Corporation, St. Louis Plant, as Unit Head—Test Engineer, Airplane Div.

Harry Paul Dobrow has joined Willys Overland Motors, Inc., as Head of Analytical Engineering Dept. He had been Consulting and Project Engineer, Office of the Chief of Ordnance, Detroit.

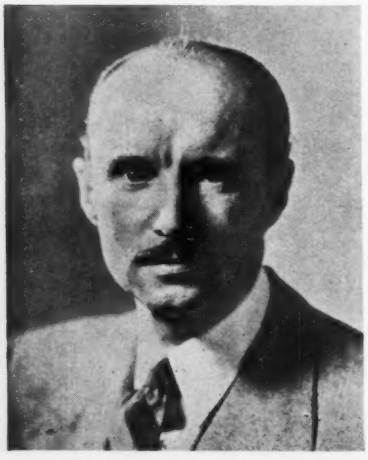
James Playfair Donnelly, formerly Executive Engineer, Nuclear Enterprises Ltd., is now Chief Engineer, Cancargo Aircraft Mfg. Company, Ltd. (Canada).

Archibald Stewart Durrant is Draftsman (Ground Equipment), United Air Lines, Inc. A veteran of the A.A.F., he previously had been Draftsman with The Glenn L. Martin Company.

Walter Frank Eade, former Lt. Comdr., U.S.N., is Chief Draftsman, Gas Turbine Div., De Laval Steam Turbine Company.

C. L. Egtvedt, Chairman, Boeing Aircraft Company, has been re-elected to that post.

Dr. Bela K. Erdoss, of the Lehigh University faculty, has been appointed Director of the new fluid dynamics program sponsored jointly by New York University and Stevens Institute of Technology. Dr. Erdoss came to this country in 1940 and was Chief Engineer and Managing Director, Fabric Hand Printers, Brooklyn; he then became Chief Engineer, Managing Director and Vice-President of Phillipsburg Mills, Inc., N.J., joining the staff of Lehigh University in 1942.



Dr. Bela K. Erdoss.

John Foster, Executive Editor of *Aviation* (now *Aviation Week*), told the New England Aviation Council that Russia has a jet plane, based on a German model, which has achieved a speed of 660 m.p.h.

Naftali F. Frenkiel, who has joined the staff of Cornell University, was Chief of a research group in the Groupement des Recherches Aéronautiques in France. He had been incorrectly listed as Chief of the Groupement in the April issue of the REVIEW.

Cedric Giles has been elected a Director of American Rocket Society, Inc.

Harold Robert Goodman has returned from military leave and is now Aeronautical Engineer at Langley Memorial Aeronautical Laboratory, N.A.C.A.

Gunther R. Graetzer, formerly Research Associate—Aeronautics, Wayne University, now is Professor of Aeronautics, Air Institute of Technology, Air Matériel Command, A.A.F.

Charles Carroll Greene, former Commanding Officer, A.A.F. Training Det. with rank of Lt. Colonel, is Aeronautics Teacher, Board of Education, New York City.

William Ross Hardin, former Lt. (j.g.) U.S.N.R., is Engineer-Draftsman, Consolidated Vultee Aircraft Corporation.

Richard Arthur Hirsch has joined Bell Aircraft Corporation as Structural Test Engineer. He had been with Republic Aviation as Research Engineer.

D. W. Hood, Navy veteran, is an Engineer with Aviation Maintenance Corporation. Before his service in the Navy, Hood was with Curtiss-Wright Corporation as Draftsman in the Airplane Div.

Donald R. Jacoby resigned as Aeronautical Engineer with N.A.C.A. to join United Helicopters, Inc., as Aerodynamicist. He previously had been Aerodynamicist with Lockheed.

Dragoljub Kosta Jovanovich, formerly with Eastern Sales Engineering Company, now is Consultant with Helicopter Company. In 1945 he was Consulting Engineer, Higgins Industries.

John Joseph Justen is Jr. Petroleum Engineer, Stanolind Oil & Gas Company.

Bernard Kaiser resigned as Chief Engineer, Tata Air Lines, India, to join British European Airways Corporation as Works Planning Engineer.

Stephen Stanley Kajencki is at Cornell Aeronautical Laboratory as Aerodynamicist. An A.A.F. veteran, he formerly was Research Aerodynamicist, Airplane Div. (Buffalo Plant), Curtiss-Wright Corporation.

Joseph Kempner, now at Polytechnic Institute of Brooklyn, was Aeronautical Engineer, Langley Laboratory, N.A.C.A.

Robert Elliot Kinney is Design Engineer with John A. Roebling's Sons Company.

Nello A. Lamberti, Stress Analyst McDonnell Aircraft, resigned to become Research Lab. Analyst, Northrop Aircraft, Inc.

Richard Grant Laucher, former Liaison Engineer, Airplane Div. (Columbus Plant) and Navy Ensign, is now Research Engineer, McDonnell Aircraft Corporation.

William P. Lear, President, Lear, Inc., was re-elected at the annual directors' meeting in Chicago.

Ben Min Lee has been named Vice-President, China Industrial Company, having resigned as Engineer—Jet & Gas Turbine, Pratt & Whitney Aircraft Div., United Aircraft Corporation. A graduate student, Aeronautical Research Lab. University of Kentucky, Lee had served as 1st Lt. in the Chinese Air Force.

Joel Carl Lehmkuhl is Chief, Special Measurements, Sub Unit of Structures Branch, Aircraft Lab., Wright Field.

John Elliot Loufek is Research Assistant, McDonnell Aircraft Corporation.

Agne T. Lundgren, formerly with Douglas Aircraft Company, Santa Monica, now is Production Engineer, United Helicopters, Inc., Palo Alto.

J. A. MacLean, former Assistant Chief Engineer in Aircraft Landing Gear Engineering, Bendix Products Div., Bendix Aviation Corporation, has been named Supervisor of Quality for the division.

Frank Earl Marble is Research Physicist, Chief, Fundamental Compressor & Turbine Research Branch, Aircraft Engine Research Lab., N.A.C.A.

Paul Herriott March, Air Corps veteran, now is Experimental Bench Mechanic, Boeing Aircraft Company. He had been with Boeing before the war.

Clifford Dunham Marks has resigned as Engineer—Stress, Boeing Airplane Company, to join McDonnell Aircraft Corporation as Stress Engineer.

Thomas J. Martin, former Major, A.A.F., now is Project Engineer, Jack & Heintz, Inc.

John M. Maxwell, Jr., is Draftsman with Lewis Foundry & Machine, division of Blaw Knox Company. He had been an Engineer with Douglas Aircraft.

Frederick Carl Meltzer is Sr. Air Transport Economist, Foreign Air Transport Div., Civil Aeronautics Board.

Jerome B. Meyer, now Sr. Stress Analyst, Fairchild Aircraft Div., Fairchild Engine and Airplane Corporation, had been Structural Design Engineer, Taylorcraft Aviation Corporation, Division of Detroit Aircraft Products, Inc.

Webb Miller is Aerodynamicist, Douglas Aircraft Company, Inc.

Frank C. Mills, Jr., former Lt., U.S.N.R., joined Douglas Aircraft Company, Inc., as Aerodynamicist.

Richard M. Mock, Vice-President, Electro-mechanical Div., Lear, Inc., was re-elected to that post. He is an Associate Fellow of the Institute.

Walter L. Moore resigned as Sr. Research Engineer with Lockheed Aircraft to become Associate Professor of Civil Engineering, University of Texas.

Bernard Andrew Napier, formerly Liaison Engineer, Boeing Aircraft Company, is Aircraft Accessory & Equipment Engineer, Lear Avia, Inc.

Stefan Neumark, formerly Technical Adviser, Institute of Research for Aeronautics, Poland, is Sr. Scientific Officer, Royal Aircraft Establishment, England, and Lecturer (part-time Professor), Polish University College, England.

Gerard E. Nistal, Director Sales Promotion and Publicity, Lear, Inc., was Editor, Air Power Div. Technical Consultant, Air Age, Inc.

James Robert Nolan, formerly Engineering Designer, Consolidated Vultee Aircraft Corporation, is Product Engineer, Hobbs Mfg. Company.

Robert B. C. Noorduyn, Associate Fellow of I.A.S., is President, Burmont Inc. He was Vice-President and General Manager, Nuclear Enterprises Ltd.

Virgil J. Norris joined the Engineering Dept., Pilotless Aircraft Div., McDonnell Aircraft Corporation. He had been Personnel Director, Aircraft Service Corporation.

Stanley Conrad Olson, A.A.F. veteran, is Weights Engineer, American Overseas Airlines, Inc.

Garth Parker, former Aerodynamicist with Douglas Aircraft, now is with Canadair Ltd. in the same capacity.

Louis Amos Payne is Flight Test Aerodynamicist with Goodyear Aircraft Corporation.

Kenneth Porter Pettibone, Navy Ensign, is Research Engineer, Ford Motor Company.

Fidia James Piattelli, former General Manager and Chief Engineer, M.A.O.F. Palestine Aircraft Company, is now Director, Chief Designer and Engineer in Charge of Manufacture.

Vincent Polo has been named President, Aero-Engineering Supplies. He resigned from American Polex, Inc.

W. R. Rhoads has been appointed Manager, Lockheed Aircraft Service, Inc., Atlantic Base, at MacArthur Airport, Long Island.

Joseph Rubin, A.A.F. veteran, now is Sales Engineer, North American Steel Company.

Robert Charles Sager, formerly Flight Test Engineer, Cornell Aeronautical Lab., is Industrial Lubricants Sales Engineer for Buffalo and Erie County area, Gulf Oil Corporation.

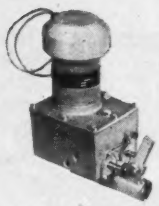
John L. Scarborough, Jr., former Lt., A.A.F., is Professor of Mechanical Engineering, Alabama Polytechnic Institute.

Ernest Jackson Schreiber, Marine Corps Lt., is Experimental Test Engineer, Pratt & Whitney Div., United Aircraft Corporation.

Kenneth Herman Schultz is Staff Engineer, Caterpillar Tractor, having left Boeing Airplane Company as Stress Engineer.

Clifford W. Schwarzmuller, former Sr. Process Engineer, Murray Corporation of America, now is engaged in engineering research of his own.

(*Continued on page 31*)



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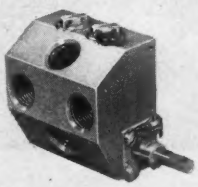

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PIN-UP OF THE MONTH—None of us must forget for a moment that at some point along the line, from drafting board to take-off, we, and we alone, are responsible for the safety of airplane crews and passengers.

Editorial

Eternal Vigilance the Price—

Take a good look at the picture on the opposite page. Better yet, cut it out, pin it up on the wall or put it under the glass on your desk. It is a picture of a plane-load of people. We don't know who they are. We don't even know whose airplane they are sitting in. It doesn't matter. What does matter very much, however, is that they are PEOPLE. They represent our ultimate customer, the traveling public. Somewhere along the line, from the inception of the design of the airplane until they are landed at their final destination, be we blueprint boy, project engineer, pilot, or top executive, their safety rests in our hands.

We are not talking here about *collective* responsibility. It is much closer to home than that. Every single person who has handled a tracing, pushed a slide rule, driven a rivet, inflated a tire, inspected a bolt, or sat in the pilot's seat carries a *personal* responsibility. At some stage in the proceedings he, and he alone, has shouldered the full responsibility. That is the thing that no one of us must ever forget.

In the spring of 1947, the future of air travel has never been brighter but, paradoxically, seldom has the present outlook seemed blacker. Legitimate pride in achievement has been dimmed by shocking disaster. Possibly we have all been a little overconfident. Possibly, because some of the things that used to be exciting and worth while in themselves have become routine, we have all tended to become a little careless. That is the worst thing that could possibly happen. C. R. Smith once said something to the effect that the air as a medium of travel was not inherently dangerous but, like the sea, it extracts a terrible toll for carelessness. That is another thing we must never forget.

About 10 years ago I wrote an editorial for *Aviation* which was addressed to air-line maintenance men, based on the old story of the Horseshoe Nail. (Because the nail was lost, the horse went lame, the General missed an important engagement, the battle was lost, etc., etc.) All of which may be classed under the head of "pure corn," these days, but there is still a lesson in it, especially for the aeronautical engineering profession. Overlooking small details that may lead to disaster is the kind of risk that none of us can afford to take. The stakes are too high.

Engineers as a group are sometimes inclined to forget that they are working for the benefit of PEOPLE. We become so absorbed in the problems of the machine *per se* that we often tend to lose sight of the ultimate purpose to which it is to be put. We sweat and strain over our performance curves, stress calculations, weight schedules, and weight estimates, making what concessions we must for the comfort and convenience of the human occupant, damning him meanwhile as one of those necessary evils without which we could make a better airplane!

So, take another look at our Pin-Up of the Month, the airplane passenger. Pilotless aircraft, guided missiles, or no, we are going to have our human customer with us for a long time. The health of our industry, and the continuation of our own jobs, depend eventually on how well we take care of him. He wants to believe in us. He wants to use our machines and our services for his business and his pleasure, but the events of the past few months have strained his faith in our abilities. We can't afford to let him down. Every member of the Institute has a personal responsibility in the matter. Think it over, and keep an eye out for loose horseshoe nails!

S.P.J.

Personal Plane Progress

Principals at Speakers Table at May 26 Dinner include *(left to right)*: John C. Squiers, Kelly-Squiers, Inc.; Willson H. Hunter, N.A.C.A.; Thomas N. Kelly, Kelly-Squiers, Inc.; William T. Piper, President, Piper Aircraft; P. R. Bassett, I.A.S. President; L. Welch Pogue, Toastmaster and President N.A.A.; Walter C. Jamouneau, Chief Engineer, Piper; and S. Paul Johnston, Director, I.A.S.

COMPARED TO THE MEETING last year, the general atmosphere seemed a little subdued. It was like waking from a pleasant dream to find stern realities and plenty of hard problems still ahead before the dream can be realized—a state not without its compensations. If the going is not to be easy, at least it is something to know the truth. If there is not immediate business enough for all, there is a real satisfaction in cooperation for the common good. The spirit of such cooperation was much in evidence, reminiscent of a time long past. And, finally, with the reappearance of the old prewar gag—that the greatest danger in aviation is of starving to death—it was plain to all that the "good old days" are here again.

Yet there was a difference, perhaps best exemplified by a broader faith of the group and of individuals in their own product. It used to be a rarity to see an aeronautical engineer who was also a pilot. Now it is more the exception to see one who is not. At the opening session, Chairman Norris asked for a show of hands from those who had flown personal aircraft to the meeting. Nearly all representatives of manufacturing companies apparently flew (in planes of their own make) and about 20 per cent of the total attendance. Of the seven major participants in the symposium, all were active pilots but one (he had plenty of flying experience); all flew to the meeting except one (he lived within 10 miles of Detroit); and four flew light planes from New York, Washington, Middletown (Ohio), and Minneapolis, respectively.

After the usual preliminaries, the opening session on the morning of May 26 was started on its way by E. W. Norris, Vice-President—Engineering, Luscombe Airplane Corporation. The two papers (plenty for a morning session) claimed no relation to each other, but both were full of interesting material and food for further thought.

PERFORMANCE AND SAFETY

The lead-off position was well filled by F. W. Ross, of the University of Michigan, with "Unified Design for Performance and Safety Characteristics." This paper was primarily concerned with proposed quantitative criteria for overall performance and safety characteristics.

It is an old game, this search for the universal criterion of merit. The principal use hitherto of such merit criteria or formulas has been to pick the winner of a utility contest, efficiency contest, safety competition, or what not. It seems that such events, if repeated often enough, inevitably attract freakish or extreme designs whose only object is to "beat the formula," unless such a turn can be anticipated by a wise and timely revision of the formula itself. Hence, Mr. Ross seems wise in frankly admitting the vulnerability of his formulas and advocating their frequent revision from results of experience and changed conditions.

In explaining the separation of performance and safety criteria, the author gave examples showing the tendency of performance to be improved by many features unfavorable to safety and vice versa. He made

Highlights from the Detroit Meeting May 26 and 27, 1947

By

RALPH UPSON*

University of Minnesota

no attempt to evaluate the two in combination, except for certain special performance items directly affecting safety. By using the two ratings as rectilinear coordinates on a chart, however, the comparative standing of various aircraft with respect to both performance and safety is readily visualized.

His performance criterion is extremely simple, being given by the nondimensional group of multiplying factors:

$$F_p = 33{,}000\eta \frac{\Delta W}{W} \frac{\Delta HP}{HP} \frac{\Delta V}{V} = \frac{\eta \Delta W R_c}{HP}\left(1 - \frac{V_s}{V_m}\right)$$

where η is the conventional propulsive efficiency at maximum speed, $\Delta W/W$ the useful load as a proportion of gross weight, $\Delta HP/HP$ the maximum difference between thrust power available and thrust power required as a proportion of rated brake power, and $\Delta V/V_m$ the speed range between minimum and maximum as a proportion of maximum speed, all for sea-level conditions. R_c is the rate of climb in feet per minute.

The safety-rating criterion was considerably more involved and can be properly covered only in the paper itself. Although it was concerned solely with flight and ground handling characteristics, this safety rating was a summation of some 22 separate terms grouped into the main headings of performance (affecting safety), control at approach speed, stall, spin, and landing gear (ground control). These items varied all the way from a simple credit number, such as 500 for "nonspin," to a relatively involved formula, such as $5(40 - |V_s - 40|)$ for power-off stall speed.

* Professor of Aeronautical Engineering.

Viewing this part of the paper with a little more time for thought than was available at the meeting, two main targets for criticism are apparent. One is the personal judgment necessarily involved in setting up the rules themselves; the other is the personal judgment then required for their interpretation. For example, it should be possible (although difficult) to score over 500 for spin characteristics in a ship that will definitely spin. Does that mean that such a design is really safer than one that is nonspinning? The stall (or landing) speed formula gives a sharp minimum at $V_s = 40$ m.p.h. Entirely aside from design difficulties, would less speed really be less safe, especially if obtained by means other than reduced wing loading (the latter being separately accounted for)?

On the question of interpretation, does "nonspin" mean literally what it says, or can the scorer apply some reasonable part of the 500-point credit to a ship that will spin only with a fancy control technique unlikely to be used inadvertently? Still more questionable perhaps is the 200-point credit for "adequate rudder control" (in stall). What is adequate control, and how would somewhat less than the absolute optimum be scored?

Such examples serve to show that the method does not by any means get away from design "by opinion" as implied in the introduction to the paper. Rather it is a means, none the less valuable, of correlating and applying consistently the results of considered group opinion or judgment.

By way of exemplifying the method, the paper closed with an account of the Bendix Model 52 development with which the author was formerly connected. This design (in which the highly cambered and twisted rectangular wing was particularly interesting) showed a safety rating factor of 2895 and an estimated performance rating factor of 2300, both substantially higher than corresponding figures tabulated for four other existing planes.

Discussion

R. Sanders, of Erco, launched into a type of question similar to what has already been indicated by asking why sideslipping should be given a safety rating distinguished from equivalent results obtained by other means. The answer seemed to be that, however steep the glide path by other means, it could be made still steeper by slipping, which left still apparently unanswered the fundamental question as to why the facility of slipping should be given a special rating, independent of glide path control.

J. M. Gwinn started considerable discussion about the nose-wheel design as an important factor in the safety of tricycle gear, particularly its strength to resist lateral loads and the desirability of a large rolling radius. Fred Weick concurred in the desirability of a large nose wheel but mentioned the serious weight penalty that usually involves a compromise. Ross mentioned a

Robert Insley, Continental Motors Corporation, Chairman, Monday afternoon session.

laterally yielding feature on the nose wheel of the Bendix 52 which helps absorb side reactions.

Peter Altman (consultant) questioned whether rate of climb should not be given consideration, as well as angle of climb. Ross brought out in reply that such consideration was in effect given by defining the angle of climb as that developed at the speed of best (rate of) climb.

Ray Hermes jumped to the question: Why not give credit points to the margin between approach speed and stalling speed, as well as to the actual magnitude of the stalling speed. Here Ross seemed to think that the mere margin between the two speeds had no great significance, because with more margin the type of stall might still be relatively sudden, unfavorable, and without warning. He emphasized the importance of adequate stall warning, preferably a "natural" type such as in the Bendix 52 where a harmless tail buffeting can be felt at a speed 4 to 5 m.p.h. above complete stalling (presumably in power-off straight flight, other conditions being usually more critical).

Propeller Noise

The second paper "Factors Affecting the Design of Quiet Propellers," by Arthur A. Regier and Harvey H. Hubbard, of the N.A.C.A. Langley Laboratory, as presented by Mr. Regier, was a logical sequel to his and Dr. Theodorsen's pioneering paper on the same general subject at last year's meeting. Whereas last year's paper considered the general possibilities and theoretical background of the problem, the present paper not only goes further into the basic principles of designing a quiet propeller but also takes up various associated problems, results of practical tests already made and further tests now scheduled at Massachusetts Institute of Technology. As far as this paper is concerned, the payoff is a series of tests of a quiet propeller, in combination with an effective engine muffler, applied to a typical design of light plane developing 110 hp. At 300 ft. altitude, this plane at full power developed only 63 db. of noise, compared to 70 db. for an average car (15 ft.), and about 90 db. for the same airplane in its original condition. From a practical standpoint, it was stated that, at the lower noise level thus achieved, no distinct engine or propeller frequency could be heard.

When the picture of the test plane was thrown on the screen, the radical nature of the propeller got something of a laugh. In addition to being of larger diameter than is customary, it carried five blades, each of which appeared several times the size of a conventional blade. Average performance of the plane, however, was not unfavorably affected.

The factors affecting the design of a quiet propeller, as considered in this paper, are acoustical, aerodynamic, and structural. The acoustical requirements for a quiet propeller indicate the necessity for a substantial reduction in tip and rotational speeds and an increase in the number of blades. The aerodynamic requirements are that the propeller have a sufficient diameter and blade area to develop the required thrust efficiently. The structural requirements are that the propellers have a minimum of weight consistent with freedom from flutter, vibration, and excessive stresses.

Propeller noise as a whole is broken down into rotational noise due to the steady aerodynamic forces on the blades and vortex noise associated with the wake vortices. The charts show that the loudness of a propeller can be reduced to the vortex level but that further reduction will be difficult. An interesting result from the tests is that the rotational or circumferential tip speed is apparently more of a criterion than the resultant or helical tip speed.

In general, a large reduction of rotational speed of the conventional propeller will be required to quiet the propeller. This reduction in speed makes it necessary for the quiet propeller to have several times the blade area of conventional propellers. The weight of the propeller will increase to about double that of present propellers.

Discussion

In answer to Chairman Norris' question about cost, Regier simply stated that no consideration of cost had thus far come into the N.A.C.A. research. (It would appear that a rough preliminary estimate of relative propeller costs could be based on comparative weights.)

F. T. Kurt questioned the origin of the blade planform shape and was referred to the classical Goldstein factors. John Akerman (University of Minnesota) referred to the preoccupation of the paper with noise as

heard on the ground and asked about the pilot. Norris thought that, with soundproofing possibilities, the pilot problem is not so hard, but Regier said the plane's occupants seemed to get more of the vortex noise. L. Trigg (Sensenich) suggested as a specific pilot problem, in the use of a controllable pitch propeller, that the lack of sound in low pitch might cause the pilot to leave it in low. He also emphasized the essentially dual nature of the propeller problem. On the one hand, we can try to reduce the noise as much as possible by using smaller diameter propellers on the present direct-connected engines, but maximum noise reduction can only be approached by using larger diameter propellers at reduced r.p.m. Regier quickly agreed that engines *must* be geared, especially with the present tendency toward increasing r.p.m.

Weick recounted the following results on noise level in the cabin from experiments with an Ercoupe.

Standard muffler and 74-in. propeller	116 db.
Special muffler and same propeller	109 db.
Special muffler and 60-in. four-blade propeller	102 db.

(Latter gave same r.p.m. at top speed but greater on the ground. Take-off about the same but lost climb, cruise, and top speed.)

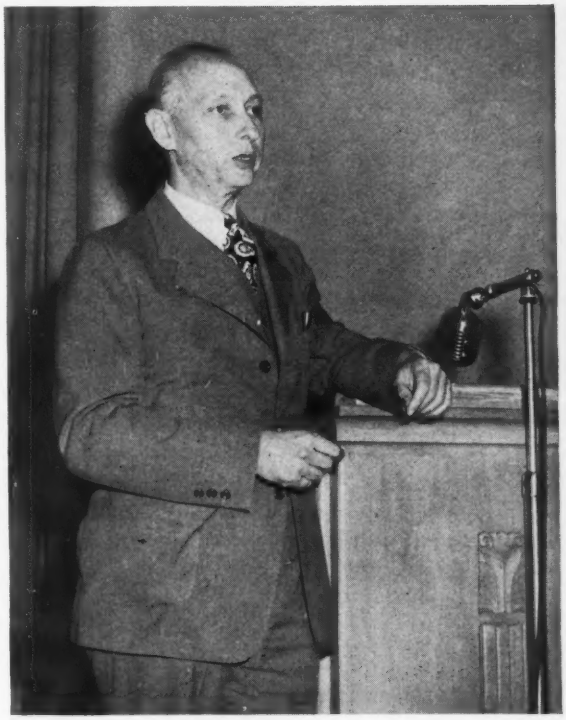
He also mentioned that results from the *muffler* seem more important to people on the ground than in the cabin. Regier said he was certainly glad to hear that cabin noise is coming down. Trigg mentioned one of his company's four-blade propellers that gave somewhat better cruise performance. In answer to Kurt's question about possible torque troubles with low propeller r.p.m., Regier said they had had none at all.

The meeting then adjourned for lunch.

Power-Plant Problems

Chairman Robert Insley, Vice-President, Continental Motors Corporation, got the afternoon session going promptly with Otto Koppen, M.I.T., presenting his paper on "An Experimental Application of the Ejector-Muffler," a good companion piece for the previous paper.

This paper brought out the antiquity of the injector-pump idea and its previous use for aircraft engine cooling. (de Ganahl, *Exhaust Pump for Engine Cooling*, Aeronautical Engineering Review, Vol. 5, No. 8, 1946.) Although such cooling appears hardly worth while for a radial engine, it should be most economical of power in any case where a mechanical boost would otherwise be required or where it is otherwise necessary to deform the cowling exit in order to produce a sufficient pressure drop to cool the engine. However, the device in its elementary form is very noisy and therefore can be applied to the airplane only in conjunction with a muffler. And since the efficiency of an ejector pump depends critically on the resistance to flow in the pump barrel, a conventional type of automotive muffler having baffles cannot be used. The major object of the paper was to bring out a satisfactory means of noise attenuation by the use of a straight-through type of muffler, in which the noise reduction is obtained by having porous, energy-absorbing walls.



Otto Koppen, Massachusetts Institute of Technology, speaking on ejector cooling and muffling.

It was found by experiment that the cooling characteristics were satisfactory. Cool air, unheated by the cylinders, circulates over the crankcase and through the accessory compartment, and, after it is heated by the cylinders and exhaust gas, it is shielded and insulated from the engine compartment.

Although the noise level was not measured, it was at least as low as that obtained in contemporary airplane muffler installations. The relatively low propeller tip speed of 650 ft. per sec. provided a sufficiently low noise level so that the exhaust noise improvement was not completely masked by propeller noise. Koppen went on to remark in a somewhat whimsical "aside" that after quieting the plane it gave the illusion of flying without effort "which is something for a Skyfarer!"

Discussion

J. H. Brewster (Fairchild) questioned why there was no inlet-bell mouth or variable exit that might be controlled by the pilot. In reply, Koppen stated that the inlet to the cylinders need only be somewhat tapered and that, in respect to a controllable exit, he was opposed to any additional control on a personal plane. Trigg suggested that some of the air might be by-passed to a cabin heater. Gwinn brought out that 60 per cent of the power loss in the exhaust is kinetic energy, thus confirming its general availability for pumping

purposes. He also asked if internal pressure distribution measurements had been taken and Akerman questioned the ratio of cooling air to exhaust gas; but Koppen said: "All we are sure of is that the engine cools."

G. E. Otter (Fleet Co.) suggested the trick of putting some of the exhaust gas and air mixture back in the carburetor, and Kurt questioned whether there was any power loss under present conditions. The answer was "no information" on the first point but that with the present arrangement the propeller turns the same r.p.m. as with a conventional exhaust system.

G. M. Preston (N.A.C.A.) was concerned about cracking of exhaust stacks. Koppen confirmed the tendency of rectangular barrels to crack but reported no trouble himself from that cause.

W. H. Hunter (N.A.C.A.) asked if some heat could not be spared for deicing of the wing leading edge. Koppen doubted this if construction is to be kept simple and cheap (although the idea still seems plausible for certain types of aircraft).

The next paper "Installation Problems with Submerged Engines," by Wm. F. Burrows and R. I. Rice, of Aircooled Motors, Inc., was a further unit in the power-plant cycle. In presenting this comprehensive paper, Mr. Burrows said that, in view of the previous paper, he would skip lightly over the subject of cooling. Not much light skipping was evident, however, and cooling problems (as well justified) seemed to comprise about half the total, other subjects being the fuel system carburetor air supply, vibration problems, propeller effects, electrical requirements, exhaust system, and various problems particularly concerned with pusher installations (evidently stemming largely from Seabee experience).

Considerable importance was placed on proper cooperation between the engine and airplane designer, for lack of which many borderline problems get insufficient attention (like each player on a tennis doubles team missing the ball in the belief that the other will get it). Concluding emphasis was put on the importance of more thorough study in the development stage as a major requirement for solution of our increasingly complex problems.

The paper impressed the present writer as an exceedingly valuable reference work, but by its very nature it did not lend itself well to oral presentation or to the kind of summary presented here. It should certainly be published. There was no discussion.

Next in line in the power-plant series was D. L. Posner, C.A.A., with "Service Experience with Aircraft Power Plant Installations." He started out by apologizing for telling troubles without giving remedies; but again the prediction was not too well fulfilled, since many remedies were clearly indicated in this interesting review of C.A.A. experience.

Information came from two sources: (1) the reports required of all accidents, and (2) the optional malfunctioning and defects reports. Data thus acquired were broken down into various categories. An attempt to show trends over a period of years was not at all conclusive because of changing conditions. Classification by source and cause, however, seemed to be really significant. Following is a somewhat abridged summary.

Source of Trouble	Number of Failures
Fuel system	2,989
Personnel (mainly pilot)	769
Power-plant controls	351
Exhaust system	298
Lubrication system	139
Miscellaneous	165
Undetermined	123
Total	4,834

It can readily be seen that the fuel system was responsible for more trouble than all the rest of the power plant combined. A classification of these fuel failures by cause is as follows:

Fuel System Failures	Number of Failures
Carburetor ice	1,094
Water in fuel	424
Dirt in fuel	400
Tank failure	173
Line failure	189
Miscellaneous	381
Undetermined	328
Total	2,989

Here the importance of carburetor ice is only too obvious, especially in view of the statement that only cases involving accident were considered. It is anyone's guess how many successful landings have been forced by carburetor ice. As brought out in discussion, it was attempted in this classification to include all accident cases involving carburetor ice even though attributed to pilot error. An incidental point of interest in this connection was that there seemed to be little correlation between such accidents and the experience of the pilot involved.

It was observed that crash-resistant tanks can prevent many crash fires and that, in any case, fuselage tanks, particularly just behind the engine, should be avoided.

As might be expected, running out of fuel held a major place in the personnel errors, but experience shows that this danger is definitely reduced with increased range. Another important source of trouble, confusion of power-plant controls, can obviously be reduced by the use of distinctive knobs. In particular reference to the fuel shut-off valve, the author felt that it should be retained but normally locked open in flight.

In conclusion the paper urged: (1) the elimination of carburetor ice (now shown to be entirely feasible);

(2) general improvement through the whole field of fuel system design; (3) improvement in phases of design and construction that will help to eliminate personnel failures; (4) and in many respects, most important, careful attention to every phase of detail design.

Discussion

George Tweney (Wayne University) asked further about the personnel classification, the answer being that, although it was mainly flight personnel, it also included some ground personnel. Wherever possible other specific causes were assigned but never with any overlapping.

Otter described an experiment of increasing the water content in the fuel and finding that it caused a gum to form in the trainer. Gwinn thereupon asked if the trouble with dirt was mainly in the strainer, but Posner thought there was more trouble with dirt elsewhere.

Hunter inquired whether there was not some way to make nonicing carburetors mandatory. Posner neatly sidestepped this one by merely observing that the use of fuel injectors is on the increase. Sanders then observed that a study of carburetor ice was made 10 years ago when it was claimed that ice-free carburetors were already coming in, but the situation today is apparently worse than it was then, at least for the personal type of plane.

R. W. Sutton (Bendix) claimed that impact ice will stop the airplane sooner than it will the engine, but Tweney cited a case of all four engines failing (perhaps not from impact ice, however).

E. E. Hayes (Capital Airlines) observed that automobiles have a better fuel tank location than most airplanes.

Chairman Kelley of the Detroit Section closed the meeting with announcements about the ensuing dinner, the landing gear demonstrations, and a film to be shown on the Navy's Douglas Skyraider.

The Dinner

Aside from the very fine food, the features of the dinner were the talks by L. W. Pogue, President of the N.A.A., and W. T. Piper, President of Piper Aircraft Corporation. Pogue outlined what various communities can do, particularly with respect to airports and markers.

Piper was in rare form with his half humorous but sound observations. A few Piperisms: "It isn't the airplane but the user that lacks utility." "We don't have to change the airplane but we will have to change our own personal habits to use it to the best advantage." "If you are taking an airplane, you should not say I will be there at 10 o'clock tomorrow to discuss your proposition, but rather I'll be there sometime soon and will look you up." "I'm tired of hearing aviation called a young man's game. The young people haven't the time or money to go into it. The biggest future of personal aviation is as an old people's game."

Tom Kelly, Detroit Section Chairman, speaking at Tuesday Luncheon. On his right, C. J. Reese, President and General Manager, Continental Motors, guest speaker. William T. Piper, *third from right.*

Flight Demonstrations

Tuesday morning was devoted to flight demonstrations at Detroit City Airport. Two different designs of cross-wind landing gear were shown applied to conventional wheel arrangement, both sponsored by the C.A.A. One was developed by the Fairchild Engine and Airplane Corporation, applied to a PT-19, and flown by Roland Rolfs. The other was a Goodyear development applied to a Piper Cub trainer and flown by Childs. As there was not enough wind for a convincing demonstration, the pilots did their best to make up for this lack by slipping the planes themselves into crabbed landings. Both ships handled beautifully as far as the take-off and landing were concerned. The Fairchild design seemed to have more positive control in taxiing, apparently because of stiffer torque restraint against swivelling of the front wheels. The Goodyear design was especially neat and compact, and it was claimed there were no special tricks to learn (beyond the differential use of brakes in taxiing).

Also on hand was a Luscombe equipped with a Stall Warning Indicator, another device sponsored by the C.A.A. and now being developed for the market by Dynar Corporation of New York. This device was set to give a positive warning at just under the speed of best climb and 12 m.p.h. above stalling speed. Being based on angle of attack, the warning speed automatically increases in a tight turn, pull-out, or gust.

Tuesday Luncheon

Lunch on Tuesday featured C. J. Reese, President of Continental Engines, whose main theme was that we will have to get more for our products; but he hastened to explain that he did not mean it for an announcement that prices on his engines were going up! (Laughter and applause from the audience.)

Design Problems

The afternoon session brought out three design papers under the chairmanship of F. T. Kurt, Project Manager, Grumman Aircraft Engineering Corporation. First up was H. G. Erickson, Structural Design Engineer, Luscombe Airplane Corporation, with "The Designer's Role in Cost Reduction." This paper should keep engineers aware of their responsibilities to turn out designs that will perform *at a price.*

Contrary to Reese's contention at the lunch, Erickson maintained that the industry must exert every possible means to provide a product with greater utility at lower cost. He pointed out, however, that no mass market as yet exists in the sense in which it is understood by automotive engineers. Nevertheless, substantial savings can be made not only with proper attention to detail design but also from the effects of general design policy on production costs. Examples were given of the importance of studying all variables in advance of detail design. Here the number of parts was undoubtedly the greatest single factor. Other largely nontechnical factors were listed as: material cost and availability in various forms (including purchased parts); type of equipment available (and relative utilization); type of personnel and skills required; nature and extent and tooling required; probable number of units to be produced; inventory on hand subject to use or obsolescence; capital available to underwrite costs; and special requirements established by management.

Some of the more specific means of reducing costs are: subassembly practice, redundant structures, automatic machines, low-density materials, detail design considerations, and interdepartmental coordination.

These principles were illustrated by a number of examples from the design of the new all-metal Luscombe 8E. Various incidental examples of cost-saving practice included elimination of left- and right-hand parts, economy in the number and size of drawings, and standardization of hole-spacing and edge distances and of the size of rivets and other fasteners. Relaxation of tolerances and allowance of alternate materials and methods of joining wherever possible have proved worth while. The paper ended with a renewed plea for the feasibility and necessity of lower costs.

Discussion

Tweney was interested in the static test results on the new stabilizer of simplified construction as compared to the old. Erickson replied simply that both stood the required load. On a question as to welded steel versus castings he said that welds were avoided whereever possible. A. O. Whipple, Jr. (United Aircraft), brought out that, contrary to common supposition, spot-welding is expensive mainly because of present C. A. A. requirements.

As might have been anticipated, the real dogfights began with the next paper, "The Flying Automobile, A Study of the Problem," by Joseph M. Gwinn, Jr., Chief Engineer, Hoist and Body Division, GarWood Industries. This paper started out with the author's definition of the terms—namely, that a roadable airplane is a plane with folding wings and other features permitting it to be driven along the highway complete with all equipment for either road or air use; but that a flying automobile is one to which wing, tail, etc., can be attached in order to make it flyable. It was the author's contention that the roadable airplane as above defined is not likely to be a good automobile but that the flying automobile can be a good automobile. He further maintained that, in any attempt to combine the two vehicles, the most important requirement is to have a good automobile. As an airplane it would be flown less, and, because on the average larger airports could be used, certain airplane compromises such as increased wing loading would be possible. Reduction of time losses at the terminal airports would more than compensate for reduced cruising speed.

With the automobile as the primary unit, he set up three possible starting points: (1) a conventional automobile of normal weight; (2) a light low-cost automobile; and (3) an automobile designed entirely with aircraft weight standards, all provided with the added structure and power to fly. For these three cases, the flying gross weight was figured to be approximately 10,000, 7,500, and 3,500 lbs., respectively, the corresponding engine powers being 700, 500, and 250 hp. and the first to carry five passengers and the others four each. It was readily concluded that the specially designed vehicle would be the cheapest and generally most feasible for the purpose.

Various further problems were concerned with streamlining, center of gravity and ride control, number of engines, propeller location, shock absorbers, wheel caster, road and flight controls, transmission, and power utilization. The last of these seemed to be one of the most serious problems because of the disparity in power averaged on the road and in flight. Several possible solutions were suggested, but the paper ended on a somewhat inconclusive note with the explanation that its purpose was not to design an actual flying automobile but to point out the problems and to give warning that to get a satisfactory overall solution will entail many long-term research programs.

Discussion

Gwinn was so bold as actually to invite hecklers, and they soon appeared—in droves! Initial discussion centered on the alleged saving of time at airports. Minor savings, such as not having to warm up the engine, were mentioned in the paper, but not a word on the time and difficulty involved in handling and mounting or demounting a wing weighing at least 400 lbs., not to mention tail surfaces. The answer in effect was that engineering ingenuity would have to be relied upon for the solution of this problem, along with the many others. There was no elaboration of the wing and tail storage

problem or of how it might be developed to make alternate airports possible.

An unlisted champion of the roadable cause here took the floor to enumerate the several obvious advantages of an airplane that could carry all its flying equipment along the highway. Gwinn reiterated the basic difficulty of such an arrangement, particularly the vulnerability of the large wing and tail surfaces to minor mishaps on the road, their susceptibility to wind forces, and their probable interference with vision. Trigg mentioned the desirability of keeping the propeller small, and Gwinn supplemented the thought that takeoff might well be facilitated by wheel traction through the automobile transmission.

Kurt finally asked the 64-dollar question: "What is all this going to cost, and, if you feel that the development is worth while, why not sell some concern on the desirability of undertaking it?" As far as the unit itself was concerned, Gwinn felt that it would be largely subject to airplane costs, say $3.50 per lb. as a rough guess. He estimated the total development cost at $5,000,000, but he modestly said he was not a good enough salesman to put it across as a business promotion!

Kurt then disclosed that the Navy has studied and rejected a serious proposal for a flying submarine. D. H. Bladen (Edo) asked Gwinn directly for his own opinion: Is the development of a flying automobile worth while? The answer is apparently yes, if someone wants to throw in $5,000,000 over a period of about 5 years. L. C. Wolfe (Aeronca) asked how Fulton does it (referring to such a unit in the East reported to have actually flown).

Then Kelly came up with the suggestion that instead of an $8,000 flying automobile (which this thing is expected to cost) why not a $1,500 auto *plus* a $6,500 airplane, although this assumes manufacturing costs for the airplane probably too high in proportion. Gwinn answered that the customer has that choice now, but he does not buy the airplane because it lacks utility.

Here Kurt asked for a show of hands as to who would like to own a flying automobile if available at the predicted $8,000 price. There were perhaps half a dozen hands in evidence. Sanders, probably voicing the opinion of a majority, said he would rather drive a $1,500 car than a $8,000 one. Collins thought that large production would change the cost picture and went on to describe Fulton's job as of somewhat odd appearance but apparently successful to date. He got something of a laugh when he visualized future highways traveled by potential airplanes and posed the question "Will this let the C.A.A. onto the highway?" Gwinn expressed his belief that the public would not accept radical looking cars. J. N. Wirtz (Goodyear) countered with the opinion that a solution depends on real (i.e. radical) improvements, such as the Spratt wing perhaps.

Gwinn brought out the great importance of indirect weight and cost, estimating that every 100 lbs. of increased equipment would involve the addition of 130 lbs. indirectly, representing the extra wing area, structure, power plant, etc. (The present writer's estimate is not quite so large; see *Aviation*, October, 1945.)

L. M. Greene (Safe Flight Instrument) brought out the serious problem of maintaining a constantly used automobile in aircraft condition. He said that with this and other problems of using the combined vehicle, if he would still need a regular car in addition, "I'd give up."

With Tweney's observation that this paper was in itself the best argument he had heard against any attempt to combine the automobile and the airplane, the chairman was finally able to clear the deck for the next paper.

The session closed with an authoritative and most interesting paper covering "Preliminary Design Studies: Piper Skysedan," by W. J. Wilkie, Chief of Design Research Department, Piper Aircraft Corporation. Although the airplane described is still in the experimental stage, a prototype has already been built and flight-tested sufficiently to confirm most of the design characteristics. It is a four-place ship with a 165-hp. engine; gross weight, 2,400 lbs., empty, 1,350 lbs., both tentative. It is interesting that Piper has here gone to a low-wing design although not tricycle wheel arrangement. (In view of the successful cross-wind landing gear development previously referred to, it now seems at least a question as to whether the tricycle arrangement can continue to hold its own against the substantially lighter "conventional" type.)

A considerable part of the paper is devoted to the wing design and various flight characteristics depending thereon, such as the gentle stall, the high spin resistance, and generally satisfactory control. It is stated that a firm but easy buffeting serves as a stall warning at 3 to 5 m.p.h. above actual stall and that a wing can still be raised in the stalled condition by use of the ailerons. The tail wheel is of the steerable disengaging type. The large fin is based on N.A.C.A. findings that large directional stability improves control characteristics for any amount of dihedral. It is hoped that this paper will be available in printed form, since it is not the kind that can be satisfactorily outlined.

Discussion

Discussion was only in the nature of questions, bringing out information largely covered in the above data. Price? "Wish I could answer," said Wilkie.

Symposium: Can the Manufacturers Make What the Users Want?

According to Webster's Dictionary, a symposium in the Greek tradition follows the banquet proper and is accompanied by music, singing, and conversation. It was Wolf who tipped me off to the full significance of the word by asking, "Where are the refreshments?" But apparently he did not realize what else he was

missing, which we trust will be duly noted for reference next time! At any rate this symposium lacked nothing in conversation. There was never a dull moment and usually your scribe, the chairman, had to pick from half a dozen eager participants.

The preliminary bout was on the stage between two teams, one of pilots and one of engineers. The line-up:

Pilots: Col. Cass S. Hough, manufacturer; Alfred Wolf, attorney; Leighton Collins, publisher.

Engineers: Fred E. Weick, Engineering and Research Corporation; Jerome D. Lederer, Aero Insurance Underwriters; Raymond Hermes, Aeronca Aircraft Corporation.

Performance

Colonel Hough, taking Performance as his main subject, started out with a plea for a more consistent basis for performance claims so that the buyer would have something more to go on than the manufacturer's "poop sheet." He then made no secret of what he thought should be minimum performance requirements: 130 m.p.h. cruising, 1,000 f.p.m. climb, 600 miles range, with a maximum 55 m.p.h. landing speed, and 1,500 ft. take-off over a 50 ft. obstacle. He emphasized that better characteristics should be expected from high performance or specially designed planes and he looked for further improvement in the future. In the "must" column he included variable pitch propellers and means of making instrument flying more generally available.

Weick, taking over for the engineers, pointed out that the C.A.A. is now furnishing a certain amount of certified performance information, particularly with respect to take-off and landing, and that information on other performance characteristics could be made available from official tests incident to the award of an Approved Type Certificate. He felt that the manufacturer should also give more information, particularly about the range that can be expected under different conditions. He showed a sample table for the Ercoupe, which gave the air speed at four different r.p.m.'s and the practical range under three different representative wind conditions, all at sea level but obviously adaptable to other altitudes as well.

He then took Colonel Hough's desired performance figures and showed in engineering terms just what would be necessary to attain them. Assuming a two-place airplane, gross weight 1,400 lbs. and wing area 160 sq.ft., he showed that with an unusually clean but possible design an engine of only 85 hp. would meet or exceed all the requirements except climb, and that very nearly. He concluded that a somewhat more practical approach would be to raise the rated horsepower to about 110 and use retractable wheels but no ultrarefinement of streamlining. It may be noted, however, that he assumed sea-level cruising at only 60 per cent of rated power, which would still be only 78 per cent of 85 hp., a percentage quite commonly used at the present time. Also his wing loading of 8.75 would seem unnecessarily low if modern flaps are to be used. He agreed with Colonel Hough in effect that we must approach closer to means for all-weather flying.

Safety

Wolf here recovered the ball for the pilots and went into the matter of safety. The two principal dangers were taken to be (1) forcible contact with the ground, and (2) horizontal collision in flight. Speaking of the helicopter (in its present stage of development) as a solution for item (1), he said he had never been a flagpole sitter or tightrope walker, but he thought either of those professions would be more restful than the "whirly birds." He also disliked parachutes as bulky, heavy, and unreliable. What he really wanted was some means of slow automatic power-off descent for the whole airplane. As to a solution for item (2), he felt much encouraged by recent electronic developments.

Speaking for the A.O.P.A., of which he is a member, he listed several other somewhat more specific items that would improve flying safety, including: nonspin characteristics; a light, inexpensive automatic pilot; emergency landing lights; lightweight emergency power; floodlighting the airplane; deicers; improved landing gear; crash-resistant cockpits; and, finally, a gas gage that works!

Replying for the engineers, Lederer considered all of Wolf's objectives within the realm of practicability, given sufficient time, money, and thought. Some are already available, such as the nonspinnable airplane or a good stall warning indicator that would have an equivalent effect. He went further in advocating stall warning indicators, already in successful use, even on nonspinnable aircraft (backed up by Aero Insurance Underwriters with a reduction of premium for all planes so equipped).

On emergency power, he quoted a suggestion (Jones of Goodyear) of a low-weight pulse-jet engine, with a total life of, say, 10 hours, for any purpose requiring a quick extra kick. He understood that a light automatic pilot was just on the verge of appearing (price unannounced).

He indicated a number of possible improvements in landing lights, all tied in with the type of approach and landing speed: the best, perhaps, a powerful rotatable light supplemented by flares. He had long felt that the airplane itself should be lighted more conspicuously but did not think much of the floodlighting idea.

Deicers for small aircraft can be made, of course, but to be effective they must take care of many items besides the wing. (And how about cost?) The desire for improved landing gear should be largely met by the new castering gear (already referred to). He particularly urged that top priority be given to the design of cockpits to eliminate lethal results in survivable accidents.

Utility

Here Collins, for the pilots, went into the case for some of the many incidental but important features contributing to what may be rather loosely termed

utility. Some of these overlapped (with a different slant) items brought up by the other pilots. For example, he pointed out the greatly increased utility that could be had by being able to fly under conditions of darkness and poor visibility. With generally adequate facilities for navigation and control and for avoiding collision, the only inherent danger remaining would be that of forced landing. Two or more engines might be a solution for the latter. In an unguarded moment he then revived the idea of a roadable plane as an alternative solution for some of the same difficulties.

In the class of detail improvements, he called for noise and vibration reduction, increased range, cruising speed at least 125 m.p.h. (cf. Hough 130 m.p.h.), simple instrumentation, spin-resistant and easy-to-fly qualities.

Hermes, in reply, divided the various desired improvements into two phases of development: (1) concerned with securing maximum utility in the present vintage of airplanes; and (2) concerned with development of a vehicle more broadly useful as a means of private transportation.

With respect to phase (1), he was inclined to discourage any idea of eliminating the alibi "weather permitting," citing a number of obstacles to personal night flying and the quite rigid requirements for an instrument rating. For phase (2), he put the biggest responsibility on private initiative but also urged the long-term cooperation of governmental agencies. In this category, requiring perhaps 5 to 20 years, he put development of a real roadable with folding wings. (Here apparently, at last, is an engineering proponent of the roadable!)

Discussion from the Floor

Largely because the delegation of visiting pilots had not heard Gwinn's paper, the argument on roadables and such-like started all over again as soon as the stage preliminaries were over. Whatever else may be the matter with it, this roadable contraption has more lives than a cat. Hermes agreed with Gwinn that it would be a long-term project. Then someone wanted to know: Suppose it was developed; would the pilots want it? Collins thought yes; Wolf thought no; Hough thought the question itself unfair. Lederer asked why a person would want a roadable if he can get a helicopter. Gwinn had apparently looked into that question and stated that for the same approximate weight and cost as a two-place helicopter, you could get a four-place flying automobile with better performance. The chairman put in his two cents worth with the thought that with the increasing number of airports and usable landing strips, and a more comprehensive plane and car rental system, a combined type of vehicle would not be so important. C. R. Beltz thought it would be even better in bad weather; but Wolf and Tweney maintained that the economic chances were against any combination type of vehicle, this being apparently borne out even for the comparatively simple amphibian. Mr. Piper is credited with the final word on this subject, not at the meeting but at the airport the next day in just the kind of weather that would make a roadable useful. He is said to have remarked somewhat wishfully, "I hope *all* my competitors decide to develop roadables."

With that subject finally out of the way, the next question was on instrument flying. Weick was much more optimistic on this than Hermes had been, maintaining that a two-control easy-to-fly plane with a single flight-control instrument (instead of three) could be easily flown blind under most conditions. Gwinn suggested that a ball-bank could serve as a turn indicator in a two-control plane of a type that always slips in a turn; Weick stated that this had been tried but was unsatisfactory in rough air. Kurt turned back to the pessimistic view of personal blind flying because of the icing and other implications involved. Greene confessed that he does not like to fly blind even in a twin-engined ship.

Launching out into other subjects, Greene urged as our first concern the problem of flying our present planes safely. He gave recent statistics showing that stalling is still way out in front as *the* number-one killer, the results also showing a condition somewhat similar to that of carburetor icing in that the number of stall accidents as a proportion of the total seemed almost independent of the pilot's experience (although presumably less in proportion to the number of flying hours for the more experienced pilots).

Further on the subject of safety, discussion turned to twin engines. Referring to a claim that for the same total power, two engines ought to be cheaper than one, Hermes said the figures failed to bear this out (it would certainly not be true for the power plant fully installed). Lederer revealed insurance data showing that many forced landings would have occurred with twin engines, due to improper maintenance, exhaustion of fuel, etc. He leaned toward serious consideration of means for attaining Wolf's suggested slow letdown.

Piper here protested that he had so far heard only one casual reference to the cost of all these extra features. He asked in effect: What use is *anything* to a person who hasn't the money to buy it? He maintained that a roomy four-passenger plane, to have any chance of wide acceptance, should not cost more than $3,000.

Mrs. Hammond (one of several women pilots present) suggested the following items for design attention: (1) vision in the air and on the ground; (2) means for stepping into the plane to eliminate climbing into it; (3) safe parking in wind, etc., perhaps aided by wing spoilers; (4) simplified instrument flying; and (5) means of keeping planes safely separated. Commenting on the safe parking item, Lederer brought out that in one month, April, 170 planes were lost on the ground, none of them with tricycle gear (unquestionably because of the low ground-angle of attack; and, like black sheep, there are fewer of such planes).

(*Continued on page 31*)

I.A.S. Briefs

Summaries of current papers received for publication or presentation at I. A. S. meetings

On the Kinematics of Turbulence

By

F. N. Frenkiel

Cornell University

A short review of different correlation coefficients and spectra is presented. Some new relations between these characteristics are given for homogeneous and isotropic turbulence. The "form of a turbulent particle" has been given from the point of view of correlation.

The study of numerous experimental correlation curves shows that where their second moments are represented as functions of their first moments, the resulting points lie near a straight line.

The correlation curves may be represented by functions of the general form $R(r) = \exp.(-Klrl)\Phi(r)$ or $\exp.(-Kr^2)\times \Phi(r)$. Several examples are given of correlation functions fitted to experimental results. The use of such functions simplified the computation of spectra or of the transverse and longitudinal correlation curves, one from the other. This may be useful in studying the history of spectra of turbulence behind grids and in the boundary layer.

Buckling of Curved Sheet in Compression and Its Relation to the Secant Modulus

By

E. H. Schuette

The Dow Chemical Company

Compression tests were made on 87 curved magnesium-alloy panels with aspect ratios near unity, to determine the buckling stress. It was found that the buckling stress can be predicted with equivalent accuracy within and beyond the elastic range by the formula

$$f_{cr.} = 0.42\, E_s\, (t/R)$$

where E_s is the secant modulus.

Free Vibrations of Sweptback Wing

By

Adam T. Zahorski

Northrop Aircraft, Inc.

The frequencies and modes of free vibration, coupled in bending and twisting, of a free-free, sweptback, uniform beam, are obtained from its differential equations of motion. The modes of vibration of a nonuniform, sweptback wing are then determined by the Ritz method. The discussion of the methods and various practical aspects of the analysis are presented from an engineering rather than a mathematical point of view.

Introduction to Shock Wave Theory

By

J. G. Coffin

Kaiser Fleetwings, Inc.

The reader is assumed to be familiar in a general way with elementary mathematics, mechanics, and thermodynamics. The average worker takes many of the theorems and results required on faith. Experience has taught that he will consider a review of the fundamentals helpful and enlightening. Besides, it is possible to give quite simple proofs of practically all that is required. A great deal of time has been spent in choosing the simplest methods possible.

A complete systematic exposition of the subject (such as a textbook) has not here been attempted. This is rather a review of the essential fundamentals and the introduction of what is believed to be a simple, direct, and practical working treatment of the subject.

The simplifications result primarily from taking advantage of the principles explained in Section 1. Whatever complexity may be found in the following pages, the reader will usually find greater complexity in the existing literature covering the same subject.

Stress Analysis of Noncircular Rings for Monocoque Fuselages

By

Chi-Teh Wang and S. Ramamritham

New York University

The application of the method of least work to the analysis of fuselage rings admits two possible sources of computational error—the errors introduced in solving the simultaneous equations and the errors due to the final expressions for the bending moments around the ring being obtained, as a rule, in terms of differences of large numbers. These errors are generally recognized and methods 3, 5, and 6, are available either to eliminate the first source of error or to reduce the second source. A method that reduces both sources of error is suggested in the present paper and the advantage of such a procedure is illustrated by a numerical example.

Prediction and Reduction to Minimum Properties of Plate Compressive Curves

By

E. H. Schuette and J. C. McDonald

The Dow Chemical Company

A method is presented for predicting plate compressive curves or reducing them to minimum properties, based on the similarities that exist between such curves and the stress-strain curve for the material. Comparison with experimental results indicates that the method is satisfactory for extruded material. There are no check data for sheet material; it is possible that predicted curves for sheet material may be unconservative, though not greatly so.

A Semigraphical Method of Computing Stick Forces for Spring-Tab Controls Having Nonlinear Hinge-Moment Characteristics

By

Robert A. Mendelsohn

Langley Memorial Aeronautical Laboratory, N.A.C.A.

A method of computing stick forces for spring-tab controls is presented in which aileron and tab characteristics from wind-tunnel tests are used instead of linearized characteristics. To illustrate the method, the variation of stick force with rate of roll is calculated for two flight speeds for an assumed airplane. The calculations are made by the semigraphical method presented herein and by a method using linearized aileron and tab data to illustrate the desirability of the more complete semigraphical method for large rates of roll.

Using a chosen differential aileron control, a determination of the optimum spring strength for high rates of roll with low stick force is demonstrated for a high-speed flight condition. For equilibrium it is shown that the optimum spring strength will be dependent on the magnitude of the tab hinge moments, and for large and fast airplanes, excessive stick forces may occur for an unbalanced tab even if the tab has no spring (servotab). An extension of the semigraphical method of solution to the case of a geared spring tab is indicated.

The Associated Matrices of Bending and Coupled Bending-Torsion Vibrations

By

Walter P. Targoff

The Glenn L. Martin Company

The associated matrix of the bending vibration of a beam is developed. This is combined with the torsional matrix to obtain the associated matrix of the coupled vibration. By continued premultiplications of the associated matrices of the successive beam sections a final matrix equation is obtained relating the boundary conditions on both ends of the vibrating beam. The imbalance of any chosen end condition is plotted against the frequency constant K in fashion similar to Holzer's method. A numerical example is given. Some advantages of the method are pointed out. The extension of the analysis to the flutter problem is noted.

Supersonic Compressible Flow Past Bodies of Revolution

By

E. R. Van Driest

Eidgenossische Technische Hochschule, Zurich

The linear perturbation theory of compressible flow past bodies of revolution is discussed with regard to both potential function and stream function adjustment. Calculations are made of the compressible flow pressure on the ellipsoid of revolution.

Approximations Involved in the Linear Differential Equation for Compressible Flow

By

H. W. Sibert

University of Colorado

An investigation is made of the approximations necessary to linearize the partial differential equation defining the velocity potential for compressible flow. It is found that not only second-order terms but also a first-order term must be negligibly small compared with unity. The application of these conditions to the Ackeret therory for two-dimensional supersonic flow gives both upper and lower limits to the free-stream Mach Number for which this theory will give reliable results.

An Experimental Application of the Ejector-Muffler

By

Otto Koppen

Massachusetts Institute of Technology

Where it is necessary to deform the cowling exit in order to produce a sufficient pressure drop to cool the engine, it appears desirable to use an ejector muffler. This exhaust pump ejector has the advantage of using the waste thrust produced by the exhaust gas. It requires a proper design of nozzles so as not to produce a back thrust that would reduce the engine power directly. Because of the noise factor in an aircraft, a muffler must be used. Since the efficiency of the pump depends critically on the resistance to flow in the pump barrel, the conventional automotive baffle muffler cannot be used. The problem can be solved by the use of a straight-through type muffler with porous walls of acoustic material.

Installation Problems with Submerged Engines

By

W. F. Burrows and R. I. Rice

Aircooled Motors, Inc.

This paper presents some of the problems encountered in the submerged engine installations in the personal airplane field where the technique of arriving at a satisfactory installation requires a different approach from that used for military or transport airplanes. The development of an engine installation for a personal aircraft model cannot ordinarily justify the expenditure of research and development funds and facilities to the extent that they are available for military and transport installations.

"PACIFIC-WESTERN" ASSISTS IN AVIATION PROGRESS

This is the Convair 240, 40-passenger plane being put into service by major airlines.

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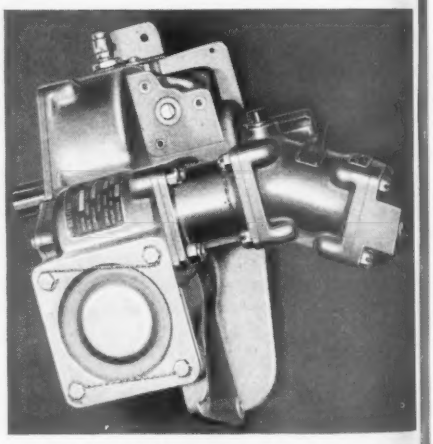
For the first time in Aviation history, Cone Gear type actuators have been designed for use aboard commercial airliners. Cone type gearing, recently added to PACIFIC-WESTERN varied lines of equipment, was selected for the Convair-240 because its high load carrying capacity results in minimum actuator weight.

PACIFIC-WESTERN engineers, alert to the fast pace of progress being made in the air, completely designed this 250:1 ratio lightweight-heavy duty wing flap actuator.



Our model 130533 Cone Gear type actuator, shown above, is rated at 5800 inch pounds torque at 10 RPM output.

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For over a half century, PACIFIC-WESTERN engineers have been designing special gears and geared products to serve industrial power transmission needs. Pioneers in the use of mechanical gear type actuators for aircraft, PACIFIC-WESTERN can help you. We invite you to consult with the specialists on our staff who are trained to serve the aircraft industry.

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GEAR PRODUCTS

The authors have briefly gone into the cooling, vibration, inlet system, fuel system, exhaust system, propeller installation, and electrical problems, illustrating the unusual problems encountered in their experience in personal-plane engine installation work, at the same time attempting to show the rather simple test means that could be employed to anticipate satisfactorily the difficulties encountered in many of the cases.

The paper's purpose is to promote a better understanding of the problems involved in personal airplane engine installations and to encourage an approach on a more sound engineering basis where sufficient time, funds, and equipment are allocated to each project, keeping in mind that the size of the undertaking will, in each case, determine the economical limit to which specific research can be carried.

Personal Plane Progress

(*Continued from page 27*)

On the broad question of utility, Koppen argued that the personal plane should not try to compete with the air lines but that it might compete with the automobile over as little as 20-mile distances (given suitable airstrips). Wolf called attention to the role of the cross-wind landing gear in making many more airports possible and reducing their cost. Miss Pelto called attention to the importance of noise reduction.

De Haven injected the safety element again, stressing the point that there comes a time for any pilot, even a good one, when he tries to do things with a plane that should not be done; and there is nothing more important for safety than to protect him against his own bad judgment.

Just at that moment, with several more trying to get in a word, the janitor appeared, to turn out the lights; so, with a forced landing due to darkness, the Fourth Annual Personal Aircraft Meeting came to an end.

News of Members

(*Continued from page 15*)

William Scudder is Lab. Assistant, University of Michigan.

Gordon C. Seavey, former staff member, M.I.T., is Chief Engineer, Ultrasonic Corporation.

Frank D. Sinclair has joined Sales Engineering, Consolidated Vultee Aircraft Corporation.

Lloyd Hamilton Sloan is Aerodynamicist with Piasecki Helicopter Corporation.

Joseph Cahill Soraghan resigned as Consulting Engineer, Percival Aviation Corporation, to join Fairchild Aircraft Div., Fairchild Engine and Airplane Corporation, as Project Structural Engineer.

Leslie V. Spencer has been named Vice-President, Bermingham, Castleman & Pierce, Inc. He had been with McCann-Erickson as Technical Aviation Writer.

Edward N. Stevensen, Jr., is Structures Engineer, Bell Aircraft Corporation.

Reagan Stunkel, former Vice-President of Lockheed Aircraft, was named President of Aviation Maintenance Corporation.

William T. Takie is Design Engineer, Aero-Flight Aircraft Corporation.

P. E. Theobald is Research Engineer, Aeronautical Research Center, University of Michigan.

Vincent C. Trimarchi has been appointed Aeronautical Engineer, Airframes & Appliances Div., C.A.A.

Mrs. Selma C. Swift Turner is now Development Engineer, Aerojet Engineering Corp.

Peter Jack Van Norde has joined Curtiss-Wright Propeller Div. as Engineer.

William W. Wagner is Stress Analyst with Consolidated Vultee Aircraft.

Paul Warsett has been appointed Professor of Aeronautical Engineering, School of Engineering, North Dakota Agricultural College.

Edward C. Wells was elected Vice-President—Chief Engineer of Boeing Airplane Company and Boeing Aircraft Company. In 1942 he received the Lawrence Sperry Award from the Institute.

Charles LeRoy White is Supervisor of Communications Training, Capital Airlines.

William Walter White has been named President of Intava, Inc.

Edward Widmayer, Jr., is Instructor of Mechanics, Rensselaer Polytechnic Institute.

Raymond R. Wiese, formerly Assistant to the Manager, Kaiser Fleetwings, Inc., has been named Secretary-Treasurer, Drafting Associates, Inc.

Theodore William Wilkins is Flight Engineer with Flota Aerea Mercante Argentina, Buenos Aires.

Clifford E. Willis, formerly with Weatherhead Company, now is Staff Engineer, Fairchild Aircraft Div., Fairchild Engine and Airplane Corporation.

J. E. Winchester, formerly Chief Engineer of Slick Airways, has been named to the engineering staff of Curtiss-Wright Airplane Div. at Columbus.

Alfred L. Wolf, former A.A.F. major, is a partner in Wolf, Block, Schorr & Solis-Cohen, law firm.

James Alan Wolfson has joined the Refinery Engineering Div., Socony-Vacuum Oil Co.

Glenn E. Wright is now Industrial Planning Specialist, Logistics Planning Div., A.M.C., A.A.F.

Howard R. Wright, Jr., is Laboratory Instructor, Aeronautical Dept., Tri-State College.

Members Elected and Transferred

Because of space limitations, the Columns of Members Elected have been omitted this month. The names of all newly elected members and transfers during the two-month period will appear in the August issue of the Review.

Heated boots for climbing ice

ICE on an airplane's cowl rings is a real threat to tail surfaces and controls. The ice builds up until the heat of the engine finally cracks it. Then, instead of slipping harmlessly off, chunks of ice *climb* in the propeller wash and are hurled at high speeds toward the tail. Sometimes these ice chunks seriously damage the tail and expensive maintenance is necessary.

To solve this problem, B. F. Goodrich has developed cowl boots of electrically heated rubber. They keep the cowls clean of ice and eliminate the penalty of increased drag and the hazard of flying ice.

Made of thin, tough rubber, the boot has wires imbedded in its core which distribute the heat uniformly over its entire surface. Tests, like the one shown above, check the carefully planned heat distribution. The heated rubber boot is very flexible, fitting tightly and smoothly to the cowl. It also can be internally installed where design permits.

Used to protect propellers, spinner domes, air intakes and other protrusions, as well as hydraulic lines, water tanks and similar installations, B. F. Goodrich heated rubber is the most efficient way of getting the right amount of heat to a specific spot. It can be adapted to any power supply. Research to make heated rubber even better is a constant project of B. F. Goodrich engineers. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

B.F.Goodrich

FIRST IN RUBBER

Aeronautical Reviews

Aerodynamics

The Aerodynamic Forces on an Oscillating Airfoil at Supersonic Speeds. John W. Miles. *Journal of the Aeronautical Sciences*, Vol. 14, No. 6, June, 1947, pp. 351–358, figs. 8 references.

The pressure distribution over an oscillating, thin airfoil of infinite span advancing at a supersonic speed is calculated by integrating the disturbances due to an appropriate distribution of sources over the forepart of the Mach cone for the point at which the pressure is desired. The result is expressed in terms of a Green's function giving the pressure at any point on the airfoil due to unit harmonic velocity at any other point on the airfoil. The lift and mid-chord moment due to plunging and pitching are expressed in terms of four complex coefficients that are functions of the reduced frequency (k) and the Mach Number (M). Asymptotic results are given for both small k and large M. The results are plotted for $M = 1.2$, 1.4, 1.6, and 2, and for $k = 0$ to 1.5. They are found to agree with the previous work of Possio (numerically) and Borbely (analytically). The results of Theodorsen for $M = 0$ and those of Possio for $M = 0.7$ are given for purposes of comparison.

Introduction to Shock Wave Theory. J. G. Coffin. *Kaiser Fleetwings, Inc.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, July, 1947.)

Supersonic Compressible Flow Past Bodies of Revolution. E. R. Van Driest. *Eidgenössische Technische Hochschule Zurich.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

Approximations Involved in the Linear Differential Equation for Compressible Flow. H. W. Sibert. *University of Colorado.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

On the Kinematics of Turbulence. F. N. Frenkiel. *Cornell University.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, July, 1947.)

Flow Conditions near the Intersection of a Shock Wave with Solid Boundary. Hsue-Shen Tsien. *Journal of Mathematics and Physics*, Vol. 26, No. 1, April, 1947, pp. 69–75, diagrs. 4 references.

Neglecting the effects of viscosity and heat conductance, there is a simple relation between the Mach Number near the intersection of the shock with the solid boundary and the curvature of the boundary. The pressure gradients before and after the shock along the solid boundary also bear a simple relation to the curvature of the boundary. The gradient after the shock is larger than the gradient before the shock.

On Curved Shock Waves. T. Y. Thomas. *Journal of Mathematics and Physics*, Vol. 26, No. 1, April, 1947, pp. 62–68.

A mathematical development of the differentiation of shock relations; the determination of partial derivative of the velocity components behind the shock line; the variation of velocity, density, and pressure along the shock line; and the curvature of stream lines behind the shock line.

Application of the Mathematical Treatment of Shock Fronts and Vortex Flow to a Body Consisting of a Cone and a Cylinder. Fritz Kai, under the direction of W. Tollmien. (*Dresden, Technische Hochschule, Archiv Nr. 44/14*, September 23, 1944.) *Cornell Aeronautical Laboratory, Buffalo*, May, 1947. 19 pp., figs.

The flow field, under rectilinear free-stream flow conditions, was constructed for a body composed of a conical nose followed by a cylindrical section. First the flow about the nose was calculated according to the conical theory. The expansion at the beginning of the cylindrical section and the additional flow field were constructed. This field, which is behind a certain point in the shock front, is treated as a vortex because of the curvature that occurs in it. Since the shock front angle and the Mach Number are the knowns, it is necessary to combine the Taylor-Maccoll and the Busemann hodographic methods.

Non-Stationary Aerodynamic Force Coefficients at Supersonic Speeds. Peter Jordan. (*Göttingen, Aerodynamische Versuchsanstalt, Report No. B 45/J/8*, July 10, 1945.) *Cornell Aeronautical Laboratory, Buffalo*, May, 1947. 21 pp., figs. 5 references.

A complete basis for the numerical calculation of the aerodynamic force coefficients necessary for flutter analysis at supersonic speeds. The derivation of the basic equation is indicated. Partial numerical results are given for wings without ailerons.

Theory of the Nonstationary Gas Flow. IV—Plane Gas Flow with Friction Heat Transfer and Temperature Differences. Sauer. (*Deutsche Luftfahrtforschung, ZWB/FB/Re/1675/4*, July 28, 1943.) *U.S., Army Air Forces, Translation No. F-TS-949-RE*, March, 1947. 44 pp., figs. 16 references.

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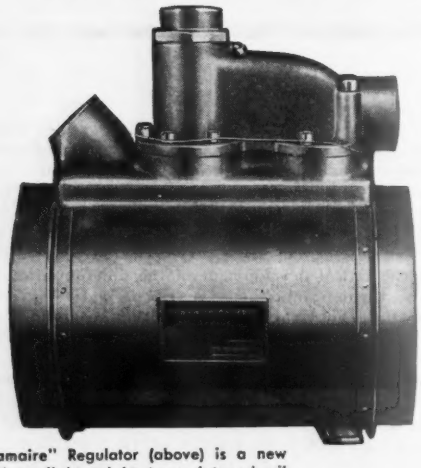

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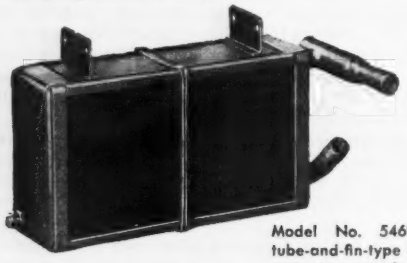

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The theory is extended to cover detonation waves, i.e., compression shocks with heat formation caused by chemical transformation in the turbulent zone. Next, the steady plane gas waves with friction and heat conduction are treated so as to show how to transform the unsteady shock front of compression into a steady pressure gradient.

On Subsonic Compressible Flows by a Method of Correspondence. II—Application of Methods to Studies of Flow with Circulation About a Circular Cylinder. Shepard Bartnoff and Abe Gelbart. *U.S., N.A.C.A., Technical Note No. 1171*, April, 1947. 39 pp., figs. 11 references. (Cf. AER 5/47:30.)

A mathematical study of the flow of a compressible fluid around a closed body by finding the compressible flow that corresponds to a given incompressible flow, applied to the case when the linearized equation of state is used. Emphasis is placed on compressible flow with circulation around a unit circle. Velocity distributions are computed around the slightly distorted circle for different free-stream Mach Numbers and different angles of attack. This method yields flows with circulation about nonsymmetric closed profiles. Tables of the constants of the transformation functions for various Mach Numbers, angles of attack, distortion of the profile from a circle, and velocity distribution on profile are given.

Approximation Method for the Graphical Determination of Two-Dimensional Supersonic Flow. L. Prandtl and A. Busemann. (*Stodola Festschrift*, Zurich, Füssli, 1929, pp. 499–509.) *Cornell Aeronautical Laboratory, Buffalo*, November, 1946. 13 pp., figs.

Two-dimensional stationary potential flow at supersonic velocity can be replaced as an approximation by an intersecting system of stationary sound waves. A method is given for graphing such a system for arbitrary initial and boundary conditions.

On a Function-Theory Method for Obtaining Potential-Flow Patterns of a Compressible Fluid. Abe Gelbart. *U.S., N.A.C.A., Advance Restricted Report No. 3G27 (Wartime Report No. L-460)*, July, 1943. 12 pp. 2 references.

Adiabatic Flow in Pipes; An Outline of Present Knowledge of the Flow of Perfect Gases in Ducts of Constant Cross-Section. II. J. Lukasiewicz. *Aircraft Engineering*, Vol. 19, No. 217, March, 1947, pp. 86–92, figs. (Cf. AER 5/47:32.)

An interpretation of the dimensionless charts and the experimental evidence leads to the following conclusions concerning the fundamental characteristics of flow in pipes: the maximum possible increase in entropy is realized when the flow is continuous (shock free) in either the subsonic or supersonic regions; in subsonic flow in pipes the gas is expanded and in supersonic flow it is compressed. Three appendixes give a basic treatment of the mathematical aspects and include assumptions, basic equations and characteristics of one-dimensional, adiabatic flow; adiabatic flow in dimensionless variables; the one-dimensional shock wave; and the pitot tube in compressible flow.

Numerical Determination by Use of Special Computational Devices of an Integral Operator in the Theory of Compressible Fluids. I—Determination of the Coefficients of the Integral Operator by the Use of Punch Card Machines. Stefan Bergman and Leonard Greenstone. *Journal of Mathematics and Physics*, Vol. 26, No. 1, April, 1947, pp. 1–9. 5 references.

Experimental Determination of the Damping in Roll and Aileron Rolling Effectiveness of Three Wings Having 2°, 42°, and 62° Sweepback. Charles V. Bennett and Joseph L. Johnson. *U.S., N.A.C.A., Technical Note No. 1278*, May, 1947. 18 pp., illus. 5 references.

The values of damping in roll decreased with increasing sweepback. An approximate estimate of this reduction over the linear range of lift coefficient can be obtained by multiplying the straight wing value of damping in roll by the cosine of the sweepback angle. The damping roll for all three wings decreased with increasing lift coefficient. Increasing the amount of sweepback increased the amount of aileron deflection required to produce a given value of the helix angle generated by the wing tip.

Flight Tests of an Airplane Model with a 42° Swept-Back Wing in the Langley Free-Flight Tunnel. Bernard Maggin and Charles V. Bennett. *U.S., N.A.C.A., Technical Note No. 1287*, May, 1947. 28 pp., illus. 6 references.

The wing alone was statically unstable longitudinally at moderate and high lift coefficients. The complete model was statically stable over the lift range for some horizontal-tail positions. The degree of stability, however, was critically dependent on tail position. The dynamic longitudinal stability

noted in the flight tests was satisfactory except over a lift-coefficient range from 0.65 to 0.80 in which extreme difficulty was experienced in establishing the correct trim air speed and flight-path angle. This difficulty was apparently associated with a change in airflow over the wing which caused abrupt changes in the variation of wing pitching moment and model flight-path angle with lift coefficient. The dynamic longitudinal behavior was erratic in this range of lift coefficient although the static longitudinal stability from force tests of the complete model appeared to be satisfactory. The lateral oscillation was predominantly a rolling motion. The lateral control was satisfactory at low lift coefficients. At the stall the model dropped without pitching or rolling off.

Flight Tests of an Airplane Model with a 62° Swept-Back Wing in the Langley Free-Flight Tunnel. Bernard Maggin and Charles V. Bennett. *U.S., N.A.C.A., Technical Note No. 1288,* May, 1947. 24 pp., illus. 10 references. (Cf. preceding abstract.)

The model was flown successfully over a limited range of lift coefficients. The particular model wing used was found to be statically unstable longitudinally at high lift coefficients when tested alone. The addition of a horizontal tail resulted in satisfactory longitudinal stability except between lift coefficients of 0.65 and 0.70. The lateral oscillations of the model appeared to be well damped even for conditions which calculations indicated were unstable. The large value of rolling moment due to sideslip affected the controllability adversely, particularly when the directional stability was low. The lateral control became weaker with increasing angle of attack.

Boundary-Induced Upwash for Yawed and Swept-Back Wings in Closed Circular Wind Tunnels. Bertram J. Eisenstadt. *U.S., N.A.C.A., Technical Note No. 1265,* May, 1947. 76 pp., figs. 11 references.

The tunnel-induced velocities for yawed and sweptback airfoils in a closed circular wind tunnel were determined. The calculations were performed for elemental horseshoe vortexes having one tip of the bound vortex on the tunnel axis for a range of yaw angles and bound-vortex lengths. From these results the correction for complete yawed and sweptback wings of arbitrary span loading may be obtained by a superposition of solutions.

Low-Speed-Stability and Damping-In-Roll Characteristics of Some Highly Swept Wings. Bernard Maggin and Charles V. Bennett. *U.S., N.A.C.A., Technical Note No. 1286,* May, 1947. 21 pp., illus. 6 references.

Swept wings of aspect ratio 5.9 were longitudinally unstable at the stall. Reducing the aspect ratio of the sweptback or sweptforward wings tended to eliminate this instability. Sweepforward produced a maximum value of negative effective dihedral approximately one-half of the maximum value of positive effective dihedral produced by sweepback. Over the linear range of the lift curve the sweptforward wings had zero directional stability, whereas the sweptback wings had a marked increase in directional stability with lift coefficients above 0.3. The damping in roll was reduced with the reduction in aspect ratio over the linear range of the lift curve. Above the linear range of the lift curve the damping in roll decreased with increasing lift coefficient for sweptback wings and increased with increasing lift coefficient for the sweptforward wings. Autorotation at the stall was obtained only with the sweptback wing having an aspect ratio of 2.

Investigation of Stability and Control Characteristics of an Airplane Model with Skewed Wing in the Langley Free-Flight Tunnel. John P. Campbell and Hubert M. Drake. *U.S., N.A.C.A., Technical Note No. 1208,* May, 1947. 29 pp., illus. 3 references.

Preliminary and qualitative indications are that a wing can be skewed as a unit to angles as great as 40° without serious stability and control difficulties, in order to attain optimum performance in take-off, landing, low speeds, and also at high Mach Numbers.

The Air Forces of the Harmonically Vibrating Wing in a Compressible Medium at Subsonic Velocity (Plane Problem). II—Numerical Tables and Curves. Dietze. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/Re/1733-2,* January 24, 1944.) *U.S., Army Air Forces, Translation No. F-TS-948-RE,* March, 1947. 25 pp., figs. (Cf. AER 4/47:34.)

The forces and moments on a wing with and without a control surface are calculated for the following conditions of motion: (1) wing flapping; (2) rotation of the wing about the forward neutral axis; and (3) rotation of the control surface about its leading edge.

Numerical Solution of the Possio Integral Equation of the Vibrating Wing in Plane Subsonic Flow. II—Representation of Downwash Discontinuity for a Vibrating Plane with a Sharp Bend in Plane Subsonic Flow. Schade. (*Göttingen, ZWB/UM/Re/-3210,* November, 1944.) *U.S., Army Air Forces, Translation No. F-TS-987-RE,* March, 1947. 18 pp. 2 references.

It is shown that it is possible to obtain an exact expression for the down-wash at the edge. At the edge, the pressure function has a logarithmic singularity, analogous to the case of steady flow.

Investigations of Effects of Surface Temperature and Single Roughness Elements on Boundary-Layer Transition. Hans W. Liepmann and Gertrude H. Fila. *U.S., N.A.C.A., Technical Note No. 1196,* April, 1947. 31 pp., illus. 14 references.

An increased temperature of the wall hastens boundary-layer transition. The effect due to gravitational forces and effect due to the dependence of the viscosity of a gas on the temperature must be distinguished. The second effect is investigated. The dependence of the viscosity on the temperature, if the fluid is a gas, leads to velocity profiles with positive curvature at the wall and therefore greater instability for a heated wall than an unheated one. With large deviation from the Blasius condition, the velocity and temperature profiles are nearly identical, as predictable theoretically for a Prandtl number of the order of 1.0. Studies of airflow in the wake of large two-dimensional roughness elements show that a laminar boundary layer can separate from the wall and reattach itself with transition. If transition takes place in the detached layer, the velocity profile in the reattached boundary layer will approach the normal turbulent-boundary-layer profile extremely rapidly. The effect of roughness elements on transition is a question of obvious importance in connection with laminar-flow airfoils, and the effect of an increased surface temperature on the position of the transition point is of importance in connection with the use of thermal deicing equipment on low-drag airfoils.

Determination of General Relations for the Behavior of Turbulent Boundary Layers. Albert E. von Doenhoff and Neal Tetervin. *U.S., N.A.C.A., Advance Confidential Report No. 3G13 (Wartime Report No. L-382),* July, 1943. 54 pp., figs. 14 references.

Preliminary Report on Laminar-Flow Airfoils and New Methods Adopted for Airfoil and Boundary-Layer Investigations. Eastman N. Jacobs. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-345),* June, 1939. 55 pp., figs. 15 references.

Boundary-Layer Control Work in Japan. T. F. Walkowicz. Interview of Prof. Ryozo Fukatsu. Kármán Mission, A.A.F. Scientific Advisory Group. *U.S., Army Air Forces, Intelligence Review No. F-IR-132-RE,* March, 1947. 60 pp., figs.

Includes report of Ryozo Fukatsu, The Effect of Suction on the Characteristics of Airfoils, which describes his attempts to control boundary-layer effect by suction along the aft portion of the upper wing surface. Pressure difference before and after the suction slot produces stepwise pressure rise with attendant flattening of the slope of the pressure distribution. This indicates effectiveness of suction for prevention of separation of both laminar and turbulent flow. This theoretic development and these experiments are claimed to be the only work on this subject done in Japan.

Exploratory Investigation of Laminar-Boundary-Layer Oscillations on a Rotating Disk. Newell H. Smith. *U.S., N.A.C.A., Technical Note No. 1227,* May, 1947. 15 pp., illus. 5 references.

With excitation by random disturbances, sinusoidal waves were observed in a narrow range of Reynolds Numbers just below the transition Reynolds Number. The wave frequency was found to be approximately a constant times the angular velocity.

Method for Calculating Wing Characteristics by Lifting-Line Theory Using Nonlinear Section Lift Data. James C. Sivells and Robert H. Neely. *U.S., N.A.C.A., Technical Note No. 1269,* April, 1947. 46 pp., figs. 11 references.

Combining the contributions of Mülthopp and others with some original work, a single complete method is developed. Simplified computing forms are given for the calculation of symmetrical lift distribution and their use is exemplified. The adaptation of the method for use with linear section lift data is also illustrated. Calculations with both linear and nonlinear section lift data are compared and presented with experimental results from three wings with symmetrical lift distributions. The calculations with nonlinear data are in close agreement over the entire

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range of lift coefficients, whereas those calculated by use of linear section lift data are in agreement over only the linear portions of the curves.

Tests in the NACA Two-Dimensional Low-Turbulence Tunnel of Airfoil Sections Designed to Have Small Pitching Moments and High Lift-Drag Ratios. Neal Tetervin. *U.S., N.A.C.A., Confidential Bulletin No. 3I13 (Wartime Report No. L-452)*, September, 1943. 36 pp., figs. 2 references.

Preliminary Report on the Characteristics of the N.A.C.A. 4400R Series Airfoils. Albert Sherman. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-451)*, March, 1939. 8 pp., figs. 6 references.

Low-Speed Tests of Five NACA 66-Series Airfoils Having Mean Lines Designed to Give High Critical Mach Numbers. Albert E. von Doenhoff, Louis S. Stivers, Jr., and James M. O'Connor. *U.S., N.A.C.A., Technical Note No. 1276*, May, 1947. 78 pp., figs. 2 references.

An effective design lift coefficient of approximately 0.1 was obtained for several airfoil sections without causing the maximum predicted critical Mach Numbers to be appreciably less than the critical Mach Numbers for the basic thickness form at zero lift. The low-drag range at a Reynolds Number of 9×10^6 decreased with increase in design lift coefficient above a value of 0.2. The pitching-moment coefficients were larger than those of airfoils having the same effective design lift coefficients with the uniform load mean line but were not nearly as large as those corresponding to the theoretic load distribution.

Effects of Mach Number and Reynolds Number on the Maximum Lift Coefficient of a Wing of NACA 230-Series Airfoil Sections. G. Chester Furlong and James E. Fitzpatrick. *U.S., N.A.C.A., Technical Note No. 1299*, May, 1947. 40 pp., illus. 9 references.

Tests indicated that peak values of maximum lift coefficient were obtained at relatively low free-stream Mach Numbers; approximately 0.20 for flaps-deflected configurations and 0.25 to 0.30 for the flaps-retracted configuration. It occurred when the critical pressure coefficient was reached on the upper surface of the wing. The values of maximum lift coefficient were increased by increasing the Reynolds Number or deflecting the flaps, but in both cases the critical pressure coefficient was reached at lower free-stream Mach Numbers.

Several Remarks on Prandtl's Rule with Regard to Two and Three-Dimensional Flow (Without Lift). B. Göthert. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/1165*, December 30, 1939.) *U.S., Army Air Forces, Translation No. F-TS-1514-RE*, April, 1947. 17 pp., figs. 2 references.

Starting from calculated examples, the differing behavior of two- and three-dimensional flow at increasing Mach Numbers is explained for slim contours. For slim elliptic cylinders and spheroids the critical Mach Numbers are calculated, i.e., the Mach Numbers at which the velocity of sound is just reached locally on the object.

Plane Nonstationary Theory of the Wing at Supersonic Speed. L. Schwarz. (*Göttingen, Aerodynamische Versuchsanstalt*, July 28, 1943.) *U.S., Army Air Forces, Translation No. F-TS-934-RE*, March, 1947. 32 pp., figs. 7 references.

The plane problem of any nonstationary movement of a wing, already worked out for a noncompressible medium, is solved for a compressible medium at supersonic speeds.

Measurement of Dynamic Pressure and Angle of Attack in the Vicinity of the Wing Tips. E. Eujen. (*Technische Berichte 9, No. 4*, September, 1942, pp. 101–105.) *Cornell Aeronautical Laboratory*, Buffalo, February, 1947. 13 pp., figs.

Since the velocity induced by the wing decreases as the distance from the wing tip increases, the induced velocity increase as compared with the free-stream velocity is unimportant for practical purposes when the probe is far enough from the wing tip, since the differences are within the limits of precision for dynamic pressure measurements. Theoretic considerations and experimental results show that the error in indication of a dynamic pressure probe placed at a given distance beyond the wing tip is due almost entirely to the sensitivity of such probes to oblique flow. The use of insensitive probes can completely replace calibration by a trailing static probe.

Calculation of the Lift Distribution over Wings of a Biplane. D. Kuchemann. (*Göttingen, ZWB/890*, November 10, 1937.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/152T*. 41 pp., figs. 41 references.

The reciprocal interference of the wings of a biplane wing unit is investigated on the assumption that the two wings can each be replaced by a vortex system in the sense of the Prandtl airfoil theory. The additional speeds produced at the local position of one wing by the presence of the other are determined according to the Biot-Savart law and reduced to a variation in the angle of incidence, which, as an additional warp, alters the lift distribution of the wings. After formulation of the general equations for the individual circulation of a biplane wing unit, calculations are made to determine the distribution over the wing spans for five examples.

Comparison of Approximation Methods for Calculating the Pressure Distribution on Profiles at Subcritical Mach Numbers with Measurements. G. Richter. (*Lilienthal-Gesellschaft für Luftfahrtforschung, Bericht Nr. 156*, Oct. 29–30, 1942, pp. 188–193.) *Cornell Aeronautical Laboratory, Buffalo*, February, 1947. 11 pp., figs.

Existing approximation methods for calculating the effect of compressibility on the pressure distribution of airfoils were investigated, in the light of test results from the D.V.L. high-speed wind tunnel, with respect to their applicability to the prediction of the change in the airfoil coefficients with Mach Numbers, and to the calculation of the critical Mach Numbers. The investigation was restricted to methods that make it possible to apply results directly from pressure distributions measured at low velocities to higher Mach Numbers, up to the vicinity of the critical Mach Number. The systematic deviations of the measured pressure distributions from the calculated ones are determined. The effect of the deviations on the change of airfoil coefficients with Mach Number is tested.

The Determination of Span Load Distribution at High Speeds by Use of High-Speed Wind-Tunnel Section Data. John Boshar. *U.S., N.A.C.A., Advance Confidential Report No. 4B22 (Wartime Report No. L-436)*, February, 1944. 30 pp., figs. 12 references.

Preliminary Experimental Investigation of Airfoils in Cascade. Arthur Kantrowitz and Fred L. Daum. *U.S., N.A.C.A., Confidential Bulletin (Wartime Report No. L-231)*, July, 1942. 22 pp., figs. 1 reference.

Note on Methods at the National Physical Laboratory and in the U.S.A. for Calculating the Profile Drag at High Speeds from Pitot Traverse Measurements. J. A. Beavan. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2102*, April 21, 1943. 10 pp. 6 references. British Information Services, New York. $0.60.

The methods used in calculating the drag of an airfoil from observations of pressure in the wake are presented. The similarity in the formulas used in England and the United States is

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

shown. A method attributed to the U.S. Air Matériel Command at Wright Field gives an approximation within $^1/_2$ per cent of the true answer.

Drag Tests of an NACA $65_{(215)}$-114, a = 1.0 Practical-Construction Airfoil Section Equipped with a 0.295-Airfoil-Chord Slotted Flap. John H. Quinn, Jr. *U.S., N.A.C.A., Technical Note No. 1236*, April, 1947. 34 pp., illus. 3 references.

By improving the surface smoothness and by decreasing the surface waviness, the section drag coefficient at a lift coefficient of 0.1 and at a Reynolds Number of 20×10^6 was decreased from 0.0045 for the original condition to 0.0038, and, at a Reynolds Number of 40×10^6, from 0.0053 to 0.0048. The Reynolds Number at which the drag began to increase with Reynolds Number was shifted from 12×10^6. The effects of deflecting the flap and sealing the gap on the lower airfoil surface were also investigated.

Drag Analysis of Single-Engine Military Airplanes Tested in the NACA Full-Scale Wind Tunnel. C. H. Dearborn and Abe Silverstein. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-489)*, October, 1940. 85 pp., illus. 17 references.

Note on the Interpretation of Wake-Survey Data and Its Use in the Estimation of Induced Drag due to Irregularities. S. Katzoff and Robert S. Finn. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-639)*, January, 1944. 13 pp., figs. 3 references.

Investigation of Drag and Pressure Distribution of Windshields at High Speeds. James B. Delano and Ray H. Wright. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-462)*, January, 1942. 58 pp., illus. 12 references.

Searching Drag Studies Check Speed Impeders. I. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 77, 78, diagrs.

A summary of tests of twelve military airplanes in the N.A.C.A. Langley full-scale wind tunnel. All protrusions on the aircraft were faired or removed. All suspected points of air leakage were sealed. A force test at an air speed of 100 m.p.h. was made and the drag determined. The seals and fairings were then progressively removed and the drag increment resulting from each change determined.

Stalling Phenomena and the Tailless Aeroplane. I. A. R. Weyl. *The Aeroplane*, Vol. 72, No. 1872, April 25, 1947, pp. 427–429, figs.

A statement of the physical phenomena accompanying stall. High incidence stall and incipient stall are described and the development of the spanwise spreading of the flow separation is discussed with reference to self-contained wing systems.

High-Speed Drag Tests of Several Fuselage Shapes in Combination with a Wing. Eugene C. Draley. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-542)*, August, 1940. 21 pp., illus. 5 references.

Full-Scale Tunnel Investigation of the Pressure Distribution over the Tail of the P-47B Airplane. Richard C. Dingeldein. *U.S., N.A.C.A., Advance Restricted Report No. 3E25 (Wartime Report No. L-439)*, May, 1943. 38 pp., illus. 7 references.

Interference of Wing and Fuselage from Tests of 30 Combinations with Triangular and Elliptical Fuselages in the NACA Variable-Density Tunnel. Albert Sherman. *U.S., N.A.C.A., Technical Note No. 1272*, May, 1947. 25 pp., illus. 3 references.

Continuation of a series of tests at large Reynolds Numbers. The results are presented for the combinations numbered 238 to 267: twelve combinations with triangular fuselages and 18 with elliptical. The wing models were the rectangular 5- by 30-in. NACA 0012 and 4412 airfoils and the NACA 0018-19 airfoil of 2:1 taper ratio.

Air Transport—General

Pinpointing Costs Per Passenger-Mile. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 97, 98. 1 reference.

Precise calculation of the costs per passenger-mile is demonstrated by the power-space-density method. A comprehensive cost-analysis worktable with basic data and equations is given. The specific computations are based on experience figures.

ICAO South Pacific Regional Groundwork Prepared: Summary of Recommendations Made at the Melbourne Meeting of the International Civil Aviation Organisation. *Aircraft* (Melbourne), Vol. 25, No. 7, April, 1947, pp. 14–17, maps.

Air Transport, Cargo

Can You Cash in on Air Cargo? I. Richard H. Rush. *Aviation Maintenance & Operations*, Vol. 7, No. 6, May, 1947, pp. 26–28, 72.

An analysis of the air-cargo industry written for the prospective investor. A check list of possible expenses and estimated operating costs is given. An estimate of the capital required, the number and type of personnel needed, and the prospect of profits is made from a review of the history of the industry from 1944 to date.

United States Exports by Air of Domestic and Foreign Merchandise: Country of Destination by Commodity, January, 1947. *U.S., Bureau of the Census, Report No. FT 732*, April, 1947. 18 pp. $0.10.

United States Exports by Air of Domestic and Foreign Merchandise: Commodity by Country of Destination, January, 1947. *U.S., Bureau of the Census, Report No. FT 731*, April, 1947. 9 pp. $0.10.

United States General Imports of Merchandise by Air: Commodity by Country of Origin, December, 1946, January, February, 1947. *U.S., Bureau of the Census, Reports No. FT 231*, February, March, April, 1947. 7, 5, 3 pp. $0.10 each.

Air Transport, Scheduled

Want to Estimate Ground and Indirect Expenses? James H. Harger. *Air Transport*, Vol. 5, No. 5, May, 1947, pp. 44–47 diagrs. 2 references.

From the statistics for the years 1931–1941, formulas are set up and curves are plotted for the ground cost operations per mile, and for general and administration costs per mile based on the route-mile turnover. The formulas are analyzed and the curves interpreted. The apparent disproportionate rise of the ground cost per mile as against the route-mile turnover is attributed to the expansion of the industry which gave rise to errors in the constants.

Transportes Aéreos Militares (TAM), Lima, Peru. *U.S., Civil Aeronautics Board, Airline Manual, Supplement*, April 25, 1947. 10 pp., map.

International Air Transport Association. William P. Hildred. *Air Affairs*, Vol. 1, No. 3, March, 1947, pp. 277–288. History of the association and an outline of its functions and responsibilities.

Long-Distance Air Services: Difficulties of Postwar Period. II. F. N. Hillier. *Modern Transport*, Vol. 57, No. 1464, April 19, 1947, p. 7. (Cf. AER 6/47:31.)

British Internal Airlines Nationalized—1947. John Stroud. *The Aeroplane Spotter*, Vol. 8, No. 183, March 22, 1947, pp 54, 55, illus. Aircraft and routes controlled by the Associated Airways Joint Committee, which now have been taken over by the British European Airways Corporation.

Airplane Descriptions

North American Develops New Navy Trainer. *Aviation*, Vol. 46, No. 4, April, 1947, p. 71, diagrs.

The XSN2J-1 advanced flight trainer for tactical, bombing, and navigation training, has a speed of 270 m.p.h., a range of 2,000 miles, and a service ceiling of 20,000 ft. Dual controls are in the rear cockpit and permit the instructor to "upset" the student's instruments. Instruments and controls are located in accordance with the Navy standardized arrangement.

North American Grooms XB-45 J-P Bomber. *Aviation*, Vol. 46, No. 5, May, 1947, p. 71, illus.

The XB-45 is a four-place medium bomber powered by four G-E-designed, Allison-built J-35 turbojets, each capable of 4,000 lbs. thrust at sea level. A refrigeration unit is reported capable of reducing the inside temperature 30° below the outside temperature.

Tailored Transport (The Convair-240). Scholer Bangs. *Air Transport*, Vol. 5, No. 5, May, 1947, pp. 21–24, illus.

Fleetwings Navy Bomber Revealed. *Aviation*, Vol. 46, No. 5, May, 1947, p. 74, illus.

The Kaiser Fleetwings XBTK-1 single-place dive torpedo bomber has a 48-ft. 8-in. span and is powered by a 2,100-hp. P&W R-2800-34 W Double Wasp engine. Rake-like dive brakes are located at the hinge of the landing flaps.

The XF2D-1 "Banshee," Navy's latest all-jet fighter plane, designed and built by McDonnell Aircraft Corporation.

New Four-Place Cessna Models Offer Range, Power, and Load (Models 190 and 195.) *Aviation News*, Vol. 7, No. 19, May 12, 1947, pp. 14, 15, illus.

The Automobile Gets Wings. W. Price. *The Saturday Evening Post*, Vol. 219, No. 46, May 17, 1947, pp. 28, 29, 51, 52, 54, 56, illus.

The Airphibian, designed by Robert Fulton Edison, Jr., is a high-wing monoplane with four-wheel, automobile-type landing gear. The forward section of the fuselage, which includes the power plant and the landing gear, can be detached from the air frame and operated as an automobile.

Technical Report on the Arado-234 (Light Bomber and Reconnaissance) Airplane (Project No. DA-6). Robert W. Shivadecker. *U.S., Army Air Forces, Technical Report No. F-TR-1139-ND*, February, 1947. 7 pp.

The Plane That Jack Built. *Aircraft and Airport*, Vol. 9, No. 3, March, 1947, pp. 20–22, 24, 50, illus.

The de Havilland DHC-2 Beaver is a high-wing monoplane, powered with a Pratt & Whitney Wasp Junior R985. The three-passenger landplane version can carry a useful load of 1,985 lbs. The freight version can carry 1,332 lbs. as a landplane and 1,125 lbs. as a seaplane.

A Modern Merchantman. *The Aeroplane*, Vol. 72, No. 1873, May 2, 1947, p. 444, figs.

The Miles Merchantman, powered by four 250-hp. de Havilland Gipsy Queen 30 engines, is designed as a freighter but can be converted into a 20-place passenger transport. Cruising speed is 155 m.p.h.

Percival Prince Will Come to Canada (Percival P-50 Prince). *Canadian Aviation*, Vol. 20, No. 5, May, 1947, p. 33, illus.

Passenger airplane or bush freighter with 56-ft. wing span powered by two Pratt & Whitney Wasp Junior engines.

The S.E.C.A.N. Type S.U.C. 10 Courlis. *The Aeroplane*, Vol. 72, No. 1873, May 2, 1947, p. 464, illus. A single-engine, high-wing light transport monoplane with pusher propeller. It is powered either by one Mathis G8R eight-cylinder, upright-V air-cooled engine or by one Renault 6Q.10 six-cylinder, inverted in-line, air-cooled engine.

The Fokker F.26 Phantom. *The Aeroplane*, Vol. 72, No. 1873, May 2, 1947, p. 464, illus.

A two-engine, low-wing, cantilever freight and passenger monoplane. It is powered by two Rolls-Royce R.B.41 Nene Series I jet units with single-stage, double-entry centrifugal compressors (straight-flow combustion with nine chambers), and a single-stage turbine. Its maximum thrust at 36,000 ft. is 1,700 lbs. with 12,400 r.p.m. at 375 m.p.h.

An Italian Fighter and Dive-Bomber (Macchi C 205). *The Aeroplane*, Vol. 72, No. 1872, April 25, 1947, p. 430, illus.

A single-engine, low-wing, cantilever monoplane, powered by a Daimler-Benz DB 605A RC 58 twelve-cylinder liquid-cooled engine. It has a three-blade constant-speed propeller. Maximum speed is 399 m.p.h. at 23,620 ft.

Airplane Design

Statics of Pressurized Cabins. Flügge and Tscheck. (*Deutsche Versuchsanstalt für Luftfahrtforschung, Bericht Nr. 1213*, May 3, 1940.) *Cornell Aeronautical Laboratory*, Buffalo, January, 1947. 32 pp., figs.

The concepts of membrane shells and shells with bending stiffness are explained. In a convex shell the bending stresses remain small and the loads are almost entirely supported by membrane forces. The membrane theory of cylindrical shells and the appropriate end-sections is given for the statics of large pressurized cabins. The three-axis ellipsoid, which is considered to be the basic type of small cabins, is calculated in detail. An example shows the shear and normal forces that a plane window frame must support in an ellipsoidal shell.

Why Produce the Otto Fighter? *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 23/33T.* 15 pp., figs.

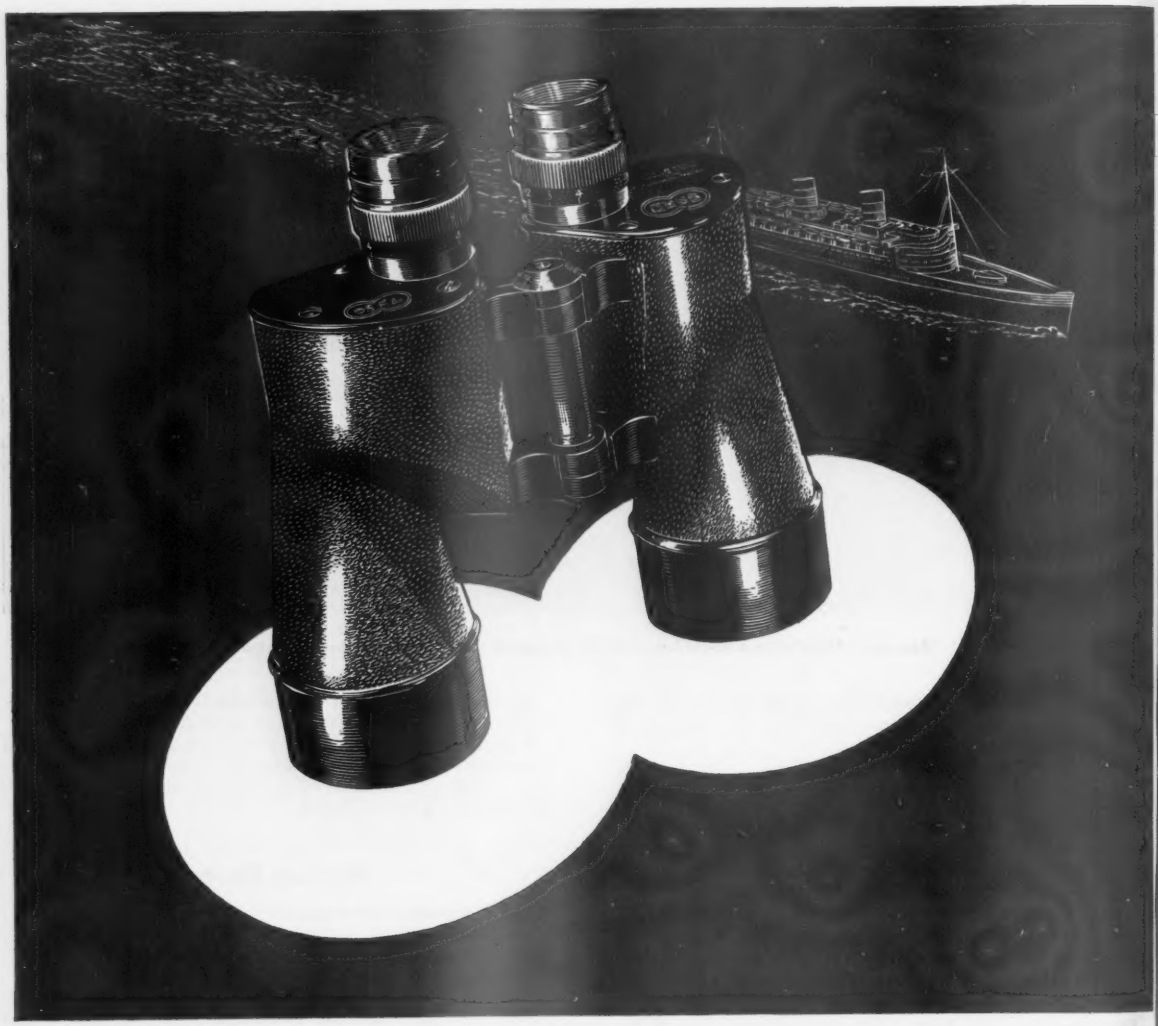
A detailed comparison of the characteristics and efficiency of the jet-powered fighter with those of fighter aircraft powered by reciprocating engines.

Simplifying Personal Plane Design. III. Ralph H. Upson. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 62–65, figs. (Cf. AER 10/46:44.)

Maximum speed, cruising speed, climb, and ceiling are analyzed, and formulas are set up in view of the empiric aircraft parameters. From these relationships it is possible to determine the proper factors to vary in order to produce the characteristics desired.

High Speed Aircraft Developments. E. H. Heinemann. *Preprint, American Society of Mechanical Engineers, National Aviation Meeting*, Los Angeles, May 28, 1947. 37 pp., diagrs.

A discussion of the difficulties to be encountered at transonic and supersonic velocities. Compressibility of air imposes new structural and aerodynamic problems. High temperatures at low altitudes and low temperatures at high altitudes introduce new strength-of-materials characteristics. The article contains an extensive graphic analysis of the history of propulsion and a discussion of the Douglas D-558 Skystreak high-speed research airplane.



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How New Douglas Skystreak Will Probe the Transonic. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 54–56, illus. (Cf. AER 3/47:45.)

The Effect of Some Design Parameters on Ditching Characteristics. John R. Dawson. *U.S., N.A.C.A., Memorandum Report No. L5G06 (Wartime Report No. L-646)*, July, 1945. 19 pp., figs. 10 references.

Design for Maintenance. T. E. G. Bowden. *Royal Aeronautical Society, Journal*, Vol. 51, No. 435, March, 1947, pp. 334–337.

Designed-In Maintenance Ease Keynoted in Douglas AD-1. W. L. Whittier. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 78–80, figs.

Component removal time and lubrication accessibility charts show that in the new Douglas AD-1 there is a 50 per cent saving in maintenance time over the previous model, the BTD-1.

Airports

German Airfield Design and Construction Methods. *Joint Intelligence Objectives Sub-Committee, Final Report No. 48.* 104 pp., figs. British Information Services, New York. $2.75.

Airways and Traffic Control

Navigational Aids. *Airports & Air Transportation* (London), Vol. 1 (N.S.), No. 47, April, 1947, pp. 481–483.

The Decca track control unit is an auxiliary to the standard Decca navigator receiver. It provides a continuous indication of position, the total distance flown, the number of minutes ahead of or behind schedule, and the ground speed.

Navigational Aids; Developments in the Miniaturization of Gee Radio Aids. II, III. P. J. Day. *Airports & Air Transportation* (London), Vol. 1 (N.S.), Nos. 45, 46, February, March, 1947; pp. 395–398; pp. 438–440; illus. (Cf. AER 4/47:42.)

Comfort in Aircraft

Air Conditioning Turbine-Propelled Aircraft. II. H. J. Wood. *Aviation*, Vol. 46, No. 4, April, 1947, pp. 56–58, figs. (Cf. AER 4/47:43.)

A discussion of refrigeration systems for cooling the cabins of high-speed aircraft with respect to their efficiency and their effect on airplane performance.

Control Systems

A Semigraphical Method of Computing Stick Forces for Spring-Tab Controls Having Nonlinear Hinge-Moment Characteristics. R. A. Mendelsohn. *N.A.C.A. Langley Memorial Aeronautical Laboratory.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

Adjustment of Stick Force by a Nonlinear Aileron-Stick Linkage. John G. Lowry. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. L-467)*, November, 1942. 8 pp., figs.

Notes and Exploratory Experiments on the Aerodynamic Balancing of Controls. H. B. Irving, A. S. Batson, and J. H. Warsap. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2076*, November 27, 1939. 34 pp., figs. 15 references. British Information Services, New York. $1.75.

The set-back hinge with the forward portion closely shrouded and the nose sealed appears to afford a balance that may be easily and reliably predicted, giving a close balance over a reasonable range of movement. Control would be improved by sealing of the nose gap and drag would be reduced slightly. It would be advantageous to adjust the width of the gap between curtain and control so that with sufficient freedom for movement of the control there would be heavy damping of the rapid oscillations such as occur in flutter.

Collection and Analysis of Wind-Tunnel Data on the Characteristics of Isolated Tail Surfaces With and Without End Plates. William R. Bates. *U.S., N.A.C.A., Technical Note No. 1291*, May, 1947. 168 pp., figs. 23 references.

The aerodynamic characteristics of 19 isolated tail surfaces were determined by wind-tunnel tests. Wind-tunnel tests were also made of rectangular airfoils of various aspect ratios with and without double end plates of various shapes. The analysis indicated that the slope of the lift curve could be predicted within 10 per cent for all models by the use of lifting-surface-theory equations. The increase in lift-curve slope provided by tip-located double end plates was shown to be dependent upon the square root of the area of the end plate divided by the airfoil span. About three-fourths of the computed values of the elevator lift-effectiveness parameters $\Delta\alpha/\Delta\delta$ agree within 10 per cent of the measured values.

The hinge-moment parameters were computed by means of lifting-surface-theory procedures for comparison with measured values. The parameters of the elevators with cutouts could not be predicted accurately. For elevators with no cutout, about 55 per cent of the calculated values for the rate of change of the hinge-moment coefficient with angle of attack C_{h_α} and about 65 per cent of the calculated values for the rate of change of hinge-moment coefficient with elevator deflection C_{h_δ} are within ± 0.0010 of the measured values.

A Lifting-Surface-Theory Solution and Tests of an Elliptic Tail Surface of Aspect Ratio 3 with a 0.5 Chord 0.85-Span Elevator. Robert S. Swanson, Stewart M. Crandall, and Sadie Miller. *U.S., N.A.C.A., Technical Note No. 1275*, May, 1947. 53 pp., diagrs. 14 references.

The aspect ratio corrections to the lift and hinge moments were calculated from the measured results. An electromagnetic-analogy model of the vortex load was constructed and tested. The vortex load was estimated from the lifting-line theory when an arbitrary fairing is near the elevator tip of a thin elliptic horizontal tail surface, with aspect ratio 3 with a plain elevator of 0.5 chord 0.85 span. The comparison of the aspect ratio corrections for the partial span with those previously presented for full-span elevators indicated that the difference in the lift parameters may be estimated satisfactorily by the lifting-line theory. This was confirmed by the results of wind-tunnel tests. Tests with a cutout for the rudder showed that the effects on the hinge moment were large.

Development of the Beech V-Tail. M. J. Gordon. *Preprint, S.A.E. National Personal Aircraft Meeting*, Wichita, May 1–2, 1947. 11 pp., figs. 5 references.

Research undertaken since 1943 has shown that tail area, the number of intersections in the tail assembly, and the trim change required with changes in power can be reduced. Production and servicing can also be simplified. An essentially two-control, non-spinnable aircraft seemed possible. Weight and drag were reduced while retaining satisfactory flying qualities. Sufficient information is available for the design of V-tails with accuracy comparable to that for conventional tails. Important design parameters are given.

Computation of Hinge-Moment Characteristics of Horizontal Tails from Section Data. Robert M. Crane. *U.S., N.A.C.A., Confidential Bulletin No. 5B05 (Wartime Report No. A-11)*, April, 1945. 33 pp., figs. 16 references.

Flight Tests of an All-Movable Vertical Tail on the Fairchild XR2K-1 Airplane. Harold F. Kleckner. *U.S., N.A.C.A., Advance Confidential Report No. 3F26 (Wartime Report No. L-397)*, June, 1943. 25 pp., illus. 4 references.

Effect of Spoiler-Type Lateral-Control Devices on the Twisting Moments of a Wing of NACA 230-Series Airfoil Sections. James E. Fitzpatrick and G. Chester Furlong. *U.S., N.A.C.A., Technical Note No. 1298*, May, 1947. 25 pp., illus. 7 references.

The results of measurements of the aerodynamic characteristics of a wing of the NACA 230-series airfoil sections tested with six spoiler configurations. The twisting moments were determined by a spanwise integration of the chordwise loadings at six stations along the left semispan of the wing. Tests were conducted at a Mach Number of 0.245 and a Reynolds Number of 7,350,000. The maximum twisting-moment coefficients of the low-angle-of-attack condition were reached at approximately 25 per cent of the semispan inboard of the spoiler. The smallest maximum twisting-moment coefficient caused by a spoiler for a given rolling-moment coefficient may be obtained by locating the outboard end of the spoiler as close to the tip as possible to take advantage of the increased balancing moment.

Two-Dimensional Wind-Tunnel Investigation of the NACA 64_1-012 Airfoil Equipped with Two Types of Leading-Edge Flap. Felicien F. Fullmer, Jr. *U.S., N.A.C.A., Technical Note No. 1277*, May, 1947. 25 pp., illus. 2 references.

An investigation of a lower-surface leading-edge flap (similar to a flap tested by the Germans but tested at a higher value of the Reynolds Number, 6.0×10^6) and an improved upper-surface

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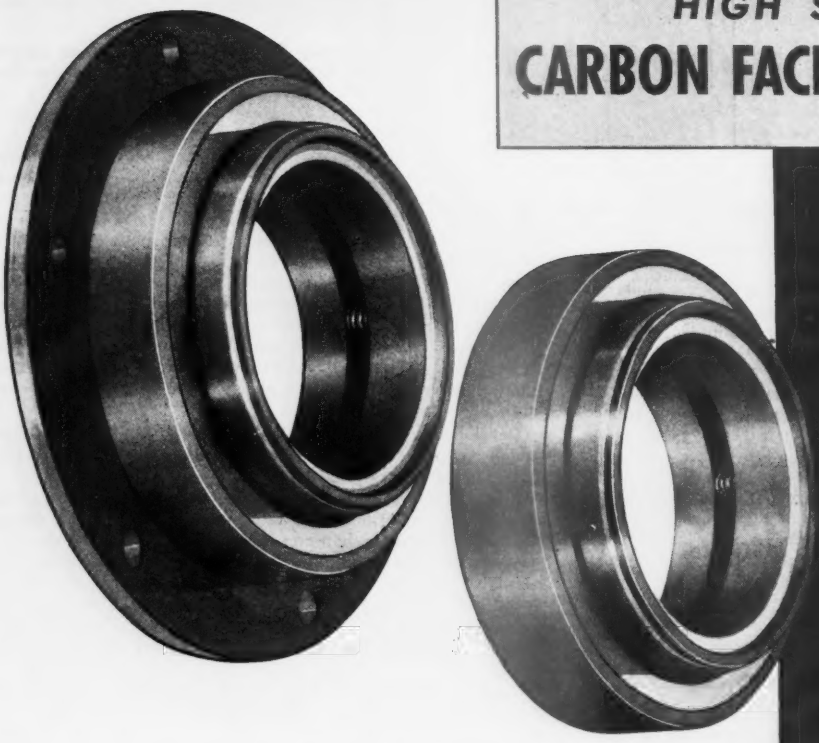

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leading-edge flap. An NACA 6-series airfoil with and without a trailing-edge split flap was used. The maximum section lift coefficient increments for the optimum upper- and lower-surface leading-edge flap arrangements on the plain airfoil were 0.43 and 0.12, respectively. The corresponding increments in the angle of attack for the maximum section lift coefficients were 4.0° and 1.4°, respectively.

Tests on an Aerofoil with 20 Per Cent Slotted Flap and an Auxiliary Flap in the Compressed Air Tunnel. R. Jones and A. H. Bell. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2101*, June, 1939. 3 pp., figs. 1 reference. British Information Services, New York. $0.30.

The Handley Page airfoil with flap at 60° was fitted with an auxiliary flap at 45° on the upper surface. The auxiliary flap displaced the lift curve in the direction of greater incidence through about 6°, with a drop in the maximum lift coefficient at high Reynolds Numbers. The flap increases drag at incidences up to 14° or 16°, and decreases the magnitude of the moment about $c/4$.

Wind-Tunnel Investigation of Control-Surface Characteristics. *U.S., N.A.C.A.* (Cf. AER 4/47:53.)

I—Effect of Gap on the Aerodynamic Characteristics of an NACA 0009 Airfoil with a 30-Percent-Chord Plain Flap. Richard I. Sears. *Advance Restricted Report (Wartime Report No. L-377)*, June, 1941. 26 pp., figs. 7 references.

II—A Large Aerodynamic Balance of Various Nose Shapes with a 30-Percent-Chord Flap on an NACA 0009 Airfoil. Richard I. Sears and H. Page Hoggard, Jr. *Advance Restricted Report (Wartime Report No. L-380)*, August, 1941. 23 pp., figs. 8 references.

IV—A Medium Aerodynamic Balance of Various Nose Shapes Used with a 30-Percent-Chord Flap on an NACA 0009 Airfoil. Milton B. Ames, Jr., and Donald R. Eastman, Jr. *Advance Restricted Report (Wartime Report No. L-355)*, September, 1941. 31 pp., figs. 8 references.

V—The Use of a Beveled Trailing Edge to Reduce the Hinge Moment of a Control Surface. Robert T. Jones and Milton B. Ames, Jr. *Advance Restricted Report (Wartime Report No. L-464)*, March, 1942. 23 pp., figs. 3 references.

XI—Various Large Overhang and Internal-Type Aerodynamic Balances for a Straight-Contour Flap on the NACA 0015 Airfoil. Richard I. Sears and H. Page Hoggard, Jr. *Advance Restricted Report (Wartime Report No. L-447)*, January, 1943. 37 pp., figs. 8 references.

XIII—Various Flap Overhangs Used with a 30-Percent-Chord Flap on an NACA 66-009 Airfoil. Clarence L. Gillis and Vernard E. Lockwood. *Advance Confidential Report No. 3G20 (Wartime Report No. L-314)*, July, 1943. 29 pp., figs. 9 references.

XIV—NACA 0009 Airfoil with a 20-Percent-Chord Double Plain Flap. Richard I. Sears and Paul E. Purser. *Advance Restricted Report (Wartime Report No. L-290)*, June, 1943. 50 pp., figs. 7 references.

XVIII—A Linked Overhang Aerodynamic Balance. Richard I. Sears and Robert B. Liddell. *Advance Confidential Report No. 4B28 (Wartime Report No. L-350)*, February, 1944. 59 pp., figs. 7 references.

Wind-Tunnel Investigation of an NACA 23021 Airfoil with Two Sizes of Balanced Split Flaps. Robert S. Swanson and Marvin J. Schuldenfrei. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-449)*, February, 1941. 31 pp., figs. 10 references.

Wind-Tunnel Investigation of Perforated Split Flaps for Use as Dive Brakes on a Tapered NACA 23012 Airfoil. Paul E. Purser and Thomas R. Turner. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-373)*, November, 1941. 22 pp., figs. 10 references.

Wind-Tunnel Investigation of a Full-Span Retractable Flap in Combination with Full-Span Plain and Internally Balanced Ailerons on a Tapered Wing. F. M. Rogallo, John G. Lowry, and Jack Fischel. *U.S., N.A.C.A., Advance Restricted Report No. 3H23 (Wartime Report No. L-506)*, August, 1943. 78 pp., figs. 12 references.

An Investigation of 0.15-Chord Ailerons on a Low-Drag Tapered Wing at High Speeds. Edmund V. Laitone. *U.S., N.A.C.A., Advance Confidential Report No. 4I25 (Wartime Report No. A-24)*, September, 1944. 45 pp., illus. 5 references.

Wind-Tunnel Investigation of a Plain Aileron with Various Trailing-Edge Modifications on a Tapered Wing. I—Aileron with Fixed Inset Tabs. F. M. Rogallo and Paul E. Purser. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-513)* September, 1942. 25 pp., figs. 5 references.

Wind-Tunnel Tests of Ailerons at Various Speeds. II—Ailerons of 0.20 Airfoil Chord and True Contour with 0.60 Aileron-Chord Sealed Internal Balance on the NACA 66,2-216 Airfoil. H. G. Denaci and J. D. Bird. **III—Ailerons of 0.20 Airfoil Chord and True Contour with 0.35-Aileron-Chord Frise Balance on the NACA 23012 Airfoil.** W. Letko and W. B. Kemp. *U.S., N.A.C.A., Advance Confidential Reports Nos. 3F18, 3I14 (Wartime Reports Nos. L-432, L-325)*, June, September, 1943. 38 pp., illus. 4 references; 32 pp., illus. 3 references.

Wind-Tunnel Development of a Plug-Type Spoiler-Slot Aileron for a Wing with a Full-Span Slotted Flap, and a Discussion of Its Application. Francis M. Rogallo and Robert S. Swanson. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-420)*, November, 1941. 26 pp., figs. 6 references.

Aerodynamic Characteristics and Flap Loads of Perforated Double Split Flaps on a Rectangular NACA 23012 Airfoil. Paul E. Purser and Thomas R. Turner. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-415)*, January, 1943. 67 pp., illus. 7 references.

Curtis Develops New Ball-Type Universal Joint. *Curtis Universal Joint Co., Inc., Release*, Recd. May 20, 1947. 1 p.

The steel forks of this light-duty joint bear on a bronze ball, which has heat-treated centerless ground pivot pins. The ball surface offers a minimum of friction loss. Boots, covers, and excessive lubrication are unnecessary.

The Root Universal Joint. *B. M. Root Co., Release*, May 28, 1947. 1 p., illus.

A ball-and-socket action joint that has a relatively small outside diameter in relation to the size of the shaft it will turn. The stress of transmitting power through the angular range of joint deflection is absorbed by two oversize keys, which provide a margin of strength at the point where failure of universal joints is most likely to occur.

Actuator Employs Friction Drive. Nils Eklund. *Machine Design*, Vol. 19, No. 4, April, 1947, p. 160, diagr.

Final drive to elevator, rudder, and ailerons of aircraft controlled by the C-2 automatic pilot is through the Lear servo-actuator, which employs an electromagnetic friction drive. Poles of the magnets consist of two smooth annular surfaces concentric with the axis of rotation geared to a common output member. Since the friction torques transmitted from the rotating magnets oppose each other, the direction of the shaft is determined by the magnet having the greatest excitation.

Electrical Equipment

Electronic Frequency Changers for Aircraft. O. E. Bowlus and P. T. Nims. *Electrical Engineering*, Vol. 66, No. 5, May, 1947, pp. 463–466, illus.

The electronic frequency changer, which is in essence an electronic commutator, can accomplish the conversion of the fluctuating-frequency a.c. power delivered by alternators geared to the engine to a constant output frequency. The device consists of a power circuit and a control circuit. The power circuit has associated with it the voltage regulating circuit, the load division circuit, the overload protection circuit, and the control circuits for starting the device and applying load. The control circuit establishes the output frequency, provides the necessary phase displacement of control signals to the power circuit to establish a three-phase output, and incorporates the necessary circuits for synchronizing two frequency changers.

Protection of Nonmetallic Aircraft from Lightning. IV—Electrocution Hazards from Inductive Voltages. National Bureau of Standards, High Voltage Laboratory. *U.S., N.A.C.A., Advance Restricted Report No. 4I28 (Wartime Report No. W-85)*, March, 1945. 48 pp., illus. 15 references.

Aluminium Wiring and Plastic Insulation in Aircraft Construction. Hollein. (*Messerschmitt Technical Report No. 21/40*, October 11, 1940.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 15/109T.* 24 pp., illus.

Electrostatic Ills and Cures of Aircraft. II—Radio Interference and Its Control. Robin Beach. *Electrical Engineering*, Vol. 66, No. 5, May, 1947, pp. 453–462, illus. (Cf. AER 5/47:53.)

Tests of wet wick, dry wick, and tufted bristle static dissipators showed that tufted bristle ionizers properly installed in adequate

numbers would reduce the potential of the airplane well below the potential gradients at which even the sharpest burrs can ionize. This prevented any static radio noise from developing.

Engine Parts and Accessories

An Experimental Application of the Ejector Muffler. Otto Koppen. *Massachusetts Institute of Technology.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

Investigations on Experimental Impellers for Axial Blowers. W. Encke. (*Göttingen, ZWB/M94/3135*, April, 1944.) *U.S., N.A.C.A., Technical Memorandum No. 1123*, April, 1947. 26 pp., figs. 4 references.

A survey of the characteristics of the experimental impellers which led to the design of an axial supercharger for use at an altitude of 5 km. This was a five-stage axial compressor with a rotor speed of 30,000 r.p.m. The flow characteristics of the successive blade designs are given in nondimensional equations.

Mechanical Seals for Rotating Shafts; An Outline of the Theories Underlying the Sealing of Rotating Components. F. E. Burger. *Aircraft Engineering*, Vol. 19, No. 217, March, 1947, pp. 93–94, diagrs.

Carbon seals that have small gaps cut in them use rubber as a resilience element. This makes unnecessary the use of a pressure spring to sustain the initial value of the seal after it is bedded down to the shaft.

Service-Proving Certified This Integral Tank. Theodore P. Hall. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 51–53, illus.

Integral wing tanks designed for the Convair-240 have heavier surfaces than separate tanks and support relatively light concentrated loads. Located in the center section, outboard of the engines, they preclude leakage hazard caused by local deflections.

Performance of Two-Stage Turbosupercharger Using Mixed-Flow Impellers. Oscar W. Schey and J. Austin King. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. E-203*), October, 1942. 12 pp., figs. 3 references.

Performance Characteristics of Mixed-Flow Impeller and Vaned Diffuser with Several Modifications. J. Austin King and Edward Glodeck. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. E-197*), July, 1942. 25 pp., illus. 2 references.

DB 601 Blower Motors, Made of Electron and Duralumin, in Centrifugal Rotation. Schmid. (*Daimler-Benz, Test Reports Nos. 10, 18, 101, 411* (*Group 1*), March, 1939.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 11/143T.* 2 pp.

The centrifugal rotation of rotors made from Elektron resulted in a permanent deformation that increased with every subsequent rotation. No extension of the rotors was found when Duralumin DM31 was used.

Control of Cylinder Temperatures by Thermostatically Operated Internal-Coolant Valves. Arnold E. Biermann, Hugh M. Henneberry, and George R. Miller. *U.S., N.A.C.A., Memorandum Report No. E5G16* (*Wartime Report No. E-200*), July, 1945. 30 pp., figs. 1 reference.

Heat-Transfer Tests of Two Steel Cylinder Barrels with Aluminum Fins Manufactured by Factory Production Method. Herman H. Ellerbrock, Jr. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. E-195*), August, 1940. 8 pp., illus. 1 reference.

Heat-Transfer Tests of a Steel Cylinder Barrel with Aluminum Fins. Herman H. Ellerbrock, Jr. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. E-194*), August, 1939. 14 pp., illus. 7 references.

Graphical Representation of Intercooler Parameters and Performance at Altitudes from 25,000 to 60,000 Feet. D. E. Brimley. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-360*), November, 1942. 22 pp., figs. 3 references.

The Theory of Oil Coolers: Heat Transfer and Pressure Drop in the Slot at Variable Viscosity. H. Schuh. (*ZWB/UM/Re/-6602*, December, 1943.) *U.S., Army Air Forces, Translation No. F-TS-931-RE*, April, 1947. 25 pp., diagrs. 6 references.

Engines—General

Morphology and Nomenclature of Jet Engines. F. Zwicky. *Aeronautical Engineering Review*, Vol. 6, No. 6, June, 1947, pp. 20–23.

A systematic classification is applied to jet engines. As a frame of reference the author uses the character of the chemical reactions, the mechanical character of the propulsive device, the character of the thrust augmentation, the physical state of the propellants, the mode of operation of the propulsive power plant, and the reaction speed of the propellants. From the various possible types of these factors a morphological box or matrix is constructed in which all possible jet engines can be outlined. This serves to show what combinations have not as yet been utilized and lays the groundwork for a system of nomenclature which will bear an intrinsic relation to the essence of the engine.

1650 H.P. Twin Wasp Announced. *United Aircraft Corp., Pratt & Whitney Aircraft Div., Release*, June 5, 1947. 5 pp.

The R-2180 Twin Wasp is a two-row, 14-cylinder radial engine with symmetrical, deep-finned cylinders, forged aluminum cylinder heads, barrel cooling muffs, and hooded cylinder baffles. Two low-tension ignition generating and distributing units are mounted on the nose section, the voltage of which is stepped up as required in the spark plugs themselves.

The Effect of Turbulence on the Flame Velocity in Gas Mixtures. Gerhard Damköhler. (*Zeitschrift für Elektrochemie und Angewandte Physikalische Chemie*, Vol. 46, No. 11, November, 1940, pp. 601–626.) *U.S., N.A.C.A., Technical Memorandum No. 1112*, April, 1947. 51 pp., diagrs. 23 references.

Comparable flame speed measurements were made in laminar and in fully developed turbulent flow. The physicochemical and the hydrodynamic aspects are analyzed in order to clarify the problem of engine combustion and other high-speed flame reactions. Turbulence always increases the flame speed in relation to the average flow cross section in two ways—for coarse-turbulence bodies exceeding the laminar flame thickness, the flame surface is enlarged by roughening or ruffling; for turbulence bodies smaller than the laminar flame thickness, the flame speed increases because all transport processes between reaction zone and preparatory zone in the flame surface are amplified by the turbulent mixing motion.

The Krupp Hydraulic Test Brake: Instructions for Operation and Maintenance. *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/4115T.* 8 pp., illus.

The Design of German Aircraft Hydraulic Systems, Fuel Systems and Fuel System Components and Accessories. Robert H. Davies and Lester J. Henderson. *Combined Intelligence Objectives Sub-Committee, Item No. 5, 25, 26, File No. 31-41.* 439 pp., figs. British Information Services, New York. $9.65.

Thornton Engine Laboratory; Research on Rich and Weak Mixture Performance, Direct Injection, Fuel Boiling and Turbine Lubrication. *Flight*, Vol. 51, No. 2008, April 24, 1947, pp. 362, 363, illus.

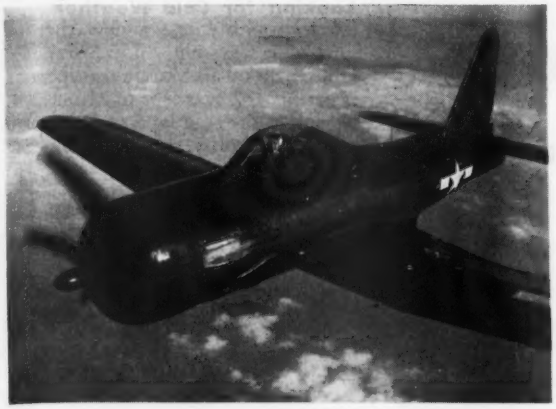
Engines, Gas Turbine

Fundamentals of the Control of Gas-Turbine Power Plants for Aircraft. I—Standardization of the Computations Relating to the Control of Gas-Turbine Power Plants for Aircraft by the Employment of the Laws of Similarity. II—Principles of Control Common to Jet, Turbine-Propeller Jet, and Ducted-Fan Jet Power Plants. H. Kühl. (*Deutsche Versuchsanstalt für Luftfahrt, Forschungsbericht Nr. 1796/1-2*, May 17, July 9, 1943.) *U.S., N.A.C.A. Technical Memorandums Nos. 1142, 1143*, April, 1947. 21 pp., figs., 11 references; 31 pp., diagrs., 11 references.

I. This standardization permits the characteristic curves of a compressor operating with a turbine to be represented and permits allowance to be made for temperature effect. It simplifies investigation of a turbine under differing operating conditions. Characteristic values for various elements of the operating behavior of the turbine are derived which will be independent of absolute pressure and temperature values. The standardization also serves as a basis for scale model tests. **II.** The pressure drop at a point of constriction with controllable flow area can be used as a control factor to limit the quantity of fuel per unit time. This can prevent exceeding the permissible gas temperature ahead of the turbine, exceeding the permissible speed, and can prevent the operation of the compressor in the unstable region. Methods of practical application are suggested.

The Determination of Elastic Stresses in Gas-Turbine Disks. S. S. Manson. *U.S., N.A.C.A., Technical Note No. 1279*, May, 1947. 30 pp., figs. 3 references.

The method is essentially a finite-difference solution of the equilibrium and compatibility equations for elastic stresses in a symmetrical disc. Account can be taken of point-to-point variations in disc thickness, temperature, elastic modulus, coefficient



The Ryan XFR-4 "Dark Shark" is serving as a flying laboratory to test propeller-driving gas turbines. This is the third version of the Navy's "Dark Shark" experimental plane using a turboprop.

of thermal expansion, material density, and in Poisson's ratio. Computations can be performed in routine fashion by nontechnical computers. The method yields results of high accuracy. Examples show the manner of treating solid discs, discs with central holes, and discs constructed either of a single material or of two or more welded materials. Shrink fitting can be taken into account.

Theoretical Notes on Some Jet Propulsion Engines. K. R. Scheuter. (*Flugwehr und -Technik* (Zurich), Vol. 8, No. 11, November, 1946, pp. 318–323.) *The Engineers' Digest*, Vol. 4, No. 4, April, 1947, pp. 151–157, diagrs. 2 references.

Since the athodyd does not yield static thrust, an aircraft so powered requires take-off aid. At high supersonic speeds, however, considerable thrusts can be expected, with correspondingly high efficiency. The gas-turbine-jet engine is best suited for high-speed aircraft since its efficiency increases with the speed. The pressure ratio of the compressor should be as great as possible; the maximum amount of air should pass through the compressor. The gas-turbine-propeller unit is superior to the pure gas-turbine-jet at low Mach Numbers; the reverse is true at higher Mach Numbers. The positive-drive ducted fan reduces the losses caused by compressibility present at the tips of free propellers because of the speed reduction in the inlet diffuser. The efficiency increases with increasing speed. The thrust per unit area can be increased by increasing the pressure ratio. At sufficiently high pressure ratio, afterburning increases the thrust considerably but reduces the efficiency rapidly. The static thrust of the gas turbine with augmenter is superior to that of the pure gas turbine. In order to effect a considerable improvement in the efficiency, the amount of air passing through the fan must be great.

Turbine Power Plant for Aircraft. Franz Losel. *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 3E/21T.* 29 pp., figs.

The development of small-bore water-tube boilers makes possible the construction of small, low-weight, economical, mobile steam power units. These could be adapted for aircraft turbine power plants.

A Higher Temperature Gas Turbine. Anthony Papini. *Diesel Power & Diesel Transportation*, Vol. 25, No. 4, April, 1947, pp. 50–53, diagrs.

Air-cooled blades for multistage gas turbines permit inlet temperatures a few hundred degrees higher than those allowable for solid blades. In the author's design, cooling air from the blades, at a density greater than usual, is discharged directly into the combustion chamber, eliminating heat losses. The air pressure through the blades can be regulated.

The Theseus I Type Tested; Bristol Turbine Propeller Unit. I, II. *Modern Transport*, Vol. 57, Nos. 1459, 1461, March 15, 29, 1947; p. 7; p. 19; illus.

Specifications of TG-100 and -180 Aircraft Gas Turbines. *General Electric Co., Aviation Div., Release*, Recd. May 7, 1947. 6 pp.

The TG-100 (A.A.F. T-31) prop-jet has a 14-stage axial-flow compressor, nine reverse-flow type combustion chambers, and a one-stage axial-flow turbine with geared propeller drive. The TG-180 (A.A.F. J-35), a turbojet engine, has an eleven-stage axial-flow compressor, eight direct-flow combustion chambers, and a one-stage axial-flow turbine.

Engines, Ram-Jet

Tests on the Lorin Model I. Pabst. (*Focke-Wulf Flugzeugbau, G.m.b.H.*, September, 1944.) *Gt. Brit., Ministry of Supply, Translation No. GDC 16/24.* 6 pp., diagrs. 4 references.

A model of the Lorin engine designed for wind-tunnel tests was tested for operation with hydrogen as a fuel. A check of the pressures in the interior of the model showed that the theoretically predicted values were attained.

Engines, Reciprocating

Coupled Vibrations of an Elastically Mounted Rigid Body with One Plane of Symmetry. R. J. Dunholter. *Journal of the Aeronautical Sciences*, Vol. 14, No. 6, June, 1947, pp. 359–363, figs. 1 reference.

An elastically mounted in-line aircraft engine is treated as a rigid body with a vertical plane of symmetry. The symmetry permits the six equations of motion to be resolved into two independent groups of three each. By using dimensionally homogeneous variables and the methods of vector-matrix analysis, the three scalar equations in each group are reduced to one. All the inertial and stiffness properties of the engine and its mounting system are contained in a single matrix coefficient called the frequency matrix. The static displacement, natural frequencies, and the dynamic magnification factors are expressed as operations on the frequency matrix. A geometric interpretation is given for the modes of motion and the relative amplitude vectors.

Installation Problems of Submerged Engines. W. F. Burrows and R. I. Rice. *Aircooled Motors, Inc.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

Practical Possibilities of High-Altitude Flight with Exhaust-Gas Turbines in Connection with Spark Ignition Engines; Comparative Thermodynamic and Flight Mechanical Investigations. A. Weise. (*ZWB/FB/430*, July 22, 1935, pp. 1–60.) *U.S., N.A.C.A., Technical Memorandum No. 1124*, April, 1947. 61 pp., diagrs. 12 references.

As a means of preparing for high-altitude flight with spark ignition engines in conjunction with exhaust-gas turbosuperchargers, various methods of modifying the exhaust-gas temperatures, which are initially higher than a turbine can withstand, are mathematically compared. It is concluded that for the present only the surface-cooling system need be considered for construction and testing. Only when the efficiency of the supercharger and turbine improve above present values will mixture cooling become practical.

The Airbox Method of Measuring the Air Consumption of Internal-Combustion Engines. L. J. Kastner. *Engineering*, Vol. 163, No. 4239, April 25, 1947, pp. 345–348, figs.

An analysis showing that the design of a satisfactory air-box meter to measure the volume of air consumed by a reciprocating engine must take into consideration not only the proportions of the meter system but also the volumetric efficiency of the engine, the cylinder swept volume, the rotational speed, the temperature of the atmosphere, the number of piston strokes per cycle, and the diameter of the orifice.

Determination of Air-Consumption Parameters for Two Radial Aircraft Engines. Sidney J. Shames and William Howes. *U.S., N.A.C.A., Memorandum Report No. E5H21* (*Wartime Report No. E-193*), August, 1945. 29 pp., figs. 1 reference.

The Effect of Altitude on Cooling. Maurice J. Brevoort, Upshur T. Joyner, and George P. Wood. *U.S, N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-386*), March, 1943. 38 pp., figs. 8 references.

The Propeller and Cooling-Air-Flow Characteristics of a Twin-Engine Airplane Model Equipped with NACA D_8-Type Cowlings and with Propellers of NACA 16-Series Airfoil Sections. James G. McHugh and Edward Pepper. *U.S., N.A.C.A., Advance Confidential Report No. L4I20* (*Wartime Report No. L-638*), September, 1944. 59 pp., illus. 7 references.

Effect of Engine-Operating Variables and Internal Coolants on Spark-Advance Requirements of a Liquid-Cooled Cylinder. John F. Pfender, Carl Dudugjian, and A. F. Lietzke. *U.S., N.A.C.A., Memorandum Report No. E5E18* (*Wartime Report No. E-198*), May, 1945. 34 pp., illus. 2 references.

Martin Memo

Published by The Glenn L. Martin Company

Baltimore 3, Maryland

On Leading Airlines Soon . . . Here, the ultramodern Martin 2-0-2 airliner is shown in flight during CAA certification tests. Speedy Martin luxury liners will soon be a familiar sight at airports the world over when they go into operation for these great airlines and cargo carriers: Capital (PCA) . . . Eastern . . . Chicago & Southern . . . United . . . Northwest . . . Delta . . . Panagra . . . Cruzeiro do Sul (Brazil) . . . Aeroposta (Argentina) . . . Nacional (Chile) . . . Mutual . . . Flying Tiger . . . Air Borne Cargo . . . U. S. . . . Willis.

Going Up . . . 235 Miles . . . Rocketry is one of the more advanced research projects of the Martin Company. Now under construction is the Neptune, first of ten experimental rockets, 45 feet long, capable of flights to 235 miles above the earth's surface. These huge rockets, being built by Martin for the Navy, are the first all-American long-range missiles of supersonic speeds.

As a Military Transport . . . The Martin 2-0-2 offers many advantages. It cruises 100 m.p.h. faster than prewar twin-engine transports. It can carry 50 completely equipped troops or 15,000 pounds of cargo. Built-in features include new thermal anti-icing equipment . . . efficient van Zelm ailerons . . . tricycle landing gear . . . large cargo doors for easy loading and unloading.

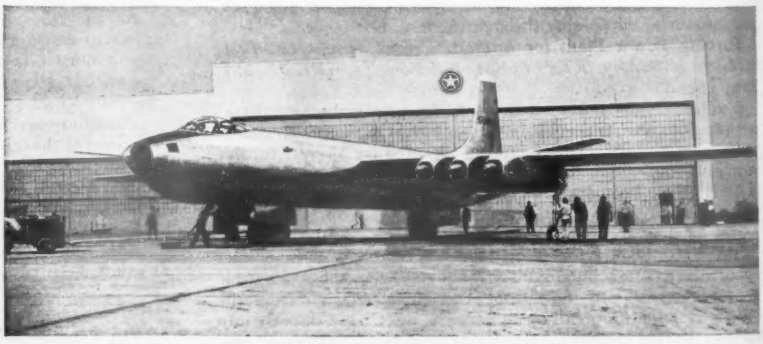
25,000 Flying Hours . . . During static tests, the Martin 2-0-2 was subjected to wrenching and straining equivalent to 25,000 hours of flying or 10 years of average service. Results of these rigorous tests are further proof of the superiority of the Martin 2-0-2's advanced design and construction.

Increased Profits for Airlines . . . The new twin-engine Martin 2-0-2 carries 36 to 40 passengers (or 15,000 pounds of airfreight in the cargo version) at speeds 100 m.p.h. faster than the planes they supplant. But more important is the fact that this modern transport needs only 19 passengers (by ATA formula) to break even. Thus, airline profits with the Martin 2-0-2 can be as high as 50% of the total passenger payload. That's one of the big reasons 15 leading airlines have ordered Martin transports.

Looking for Cold Weather . . . To thoroughly test a new thermal anti-icing system, now standard equipment on all Martin transports, a Martin 2-0-2 was sent to Minnesota. Flying in the cold layers of air north of Minneapolis, the engineers and CAA representatives were able to choose varying types of icing conditions for their experiments. The system which involves passing heated air through the wing and tail assembly proved successful . . . the experiments were acclaimed by aviation experts as a big step forward in all-weather flying.

"A Real Buy" Here's Why . . . Martin has orders for more new transports than any other manufacturer. Through quantity production Martin is able to spread the cost of Martin transports over a larger number of planes, giving purchasers these great new airliners at low cost.

Low-Cost Maintenance . . . These are not windows in the Martin 2-0-2. They are a few of the numerous accessory compartment openings which provide easy access to the 2-0-2's electrical and hydraulic systems. These built-in timesavers mean low maintenance and servicing costs. The openings shown above are in the bottom of the fuselage.



Newest Jet Bomber . . . The high-speed, long-range XB-48 was built by Martin for the Army Air Forces. Powered by six jet engines, it is the largest multi-jet conventional type plane yet constructed. The XB-48 also pioneers a new bicycle type landing gear developed by Martin for high-speed aircraft.

Martin AIRCRAFT

Builders of Dependable Aircraft Since 1909

Economy of Internally Cooling Only the Overheated Cylinders of Aircraft Engines. Arnold E. Biermann, George R. Miller, and Hugh M. Henneberry. *U.S., N.A.C.A., Memorandum Report No. E5G14 (Wartime Report No. E-202)*, July, 1945. 25 pp., figs. 3 references.

The Reduction of Nonuseful Pressure Losses on Air-Cooled Engine Cylinders by Means of Improved Finning and Baffling. M. J. Brevoort, U. T. Joyner, and George P. Wood. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-686)*, February, 1943. 6 pp. 1 reference.

Nitrous Oxide Supercharging of an Aircraft-Engine Cylinder. Max J. Tauschek, Lester C. Corrington, and Merle C. Huppert. *U.S., N.A.C.A., Memorandum Report No. E5F26 (Wartime Report No. E-199)*, June, 1945. 34 pp., figs. 7 references.

Rolls-Royce Eagle, New 24-Cylinder Sleeve-Valve Unit of 35,000 B.H.P. *Flight*, Vol. 51, No. 2000, April 24, 1947, pp. 368a–368d, 369–371, illus., cutaway drawings. (Cf. AER 4/47:51.)

The Eagle, the first Rolls-Royce sleeve-valve production engine, is a twin-crank, flat-H engine aspirated with a two-stage, two-speed supercharger, and in the Mk 22 form drives an eight-blade contrarotating propeller. The sleeve drive is a worm shaft on each side, commonly serving top and bottom rows of sleeves. It supplies over 2,000 hp. at cruising up to 20,000 ft. The header tank of the "shunt" cooling system acts as a reservoir. A centrifugal breather removes corrosive fumes from the lubrication system.

The Rolls-Royce Eagle. *The Aeroplane*, Vol. 72, No. 1872, April 25, 1947, p. 420, illus. (Cf. preceding abstract.)

Engines, Rocket

On the Thermodynamics of Rocket Propulsion. K. Schäfer. (*ZWB Report No. 847*, December 22, 1944.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/5651T.* 6 pp.

An estimate is made of the extent to which dissociation equilibrium is established during the reactive process in the thrust nozzle of a rocket propulsion unit. From this it appears that the establishment of an equilibrium can be assumed in order to obtain the accurate determination of temperature permitted by modern knowledge of calorific data.

A New Propellant Combination for Rockets, Using a Solid Oxygen Carrier and Ammonia as Fuels. G. Damkoehler and W. Eggersgluess. (*ZWB/FB/1391*, March, 1941.) *U.S., Army Air Forces, Translation No. F-TS-1041-RE*, February, 1947. 49 pp., figs.

Nitrosyl perchlorate ($NOClO_4.H_2O$), "PC2," is the oxygen-containing fuel of a NH_3-PC2 reaction system to be employed in a self-contained thrust engine. This is a solid fuel but the reaction takes place in the gaseous state. The physical and chemical properties of the compound appear to be satisfactory. The report details its production, properties, handling and storage, and includes a general discussion of thrust engines and the various fuels that can be employed in self-contained thrust systems.

Rocket Engines; American 6,000 C4 Unit for Bell XS-1; Earlier German Units Compared. *Flight*, Vol. 51, No. 1995, March 20, 1947, pp. 231, 232, illus. (Cf. AER 3/47:63.)

New Navy Rocket Aimed at Ionosphere. *Aviation News*, Vol. 7, No. 19, May 12, 1947, p. 13, diagr.

The HASR-2 Neptune built by The Glenn L. Martin Company is an alcohol-liquid oxygen type rocket designed for high-altitude research. It is expected to reach an altitude of about 237 miles with a useful load of 100 lbs. Stabilization is facilitated by mounting the engine in gimbals controlled by a gyro. Roll is corrected by releasing steam obtained from the decomposition of hydrogen peroxide from special roll jets.

Production of Concentrated Hydrogen Peroxide Solutions at Bad Lauterberg (Harz). Max Woldenberg and Lester M. White. *Combined Intelligence Objectives Sub-Committee, Item No. 22, File No. 23-18*, June 1, 1945. 30 pp., illus. British Information Services, New York. $1.00.

Production of Hydrazine Hydrate by I.G. Farben. A.G., Leverkusen. *Combined Intelligence Objectives Sub-Committee, Item No. 22, File No. 22-18*, 1945. 7 pp., figs. British Information Services, New York. $0.35.

Manufacture of Hydrogen Peroxide. B. E. A. Vigers, W. S. Wood, and G. Hickson. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 886, Item No. 22.* 20 pp., illus. British Information Services, New York. $0.70.

Hydrogen Peroxide, Production Through 2-Ethyl Anthraquinone. W. G. Gormley. *Combined Intelligence Objectives Sub-Committee, Item No. 22, File No. 19-4*, April, 1945. 7 pp. British Information Services, New York. $0.35.

Hydrogen Peroxide Electro Chemische Werke, Hollriegelskreuth. W. G. Gormley. *Combined Intelligence Objectives Sub-Committee, Item No. 22, File No. 25-44*, June, 1945. 17 pp., fig. British Information Services, New York. $0.55.

Hydrogen Peroxide Storage Practices in Three German Plants. J. E. Rehler, R. Erikson, and G. R. Wernisch. *Combined Intelligence Objectives Sub-Committee, Item No. 4, File No. 30-109*, July, 1945. 23 pp., illus. British Information Services, New York. $0.70.

Liquid Oxygen Production in France and Belgium. J. E. Lambie, T. K. Sherwood, and others. *Combined Intelligence Objectives Sub-Committee, Item No. 4, File No. 4-13 and 15, 5-23, 6-5.* 50 pp., illus. British Information Services, New York. $1.60.

Liquid Oxygen Plants in France and Belgium. J. S. Brown and R. C. Aldrich. *Combined Intelligence Objectives Sub-Committee, Item No. 30, File No. 18-2*, March 6, 1945. 6 pp. British Information Services, New York. $0.35.

Fire Prevention

Magnesium Fires in Aircraft. David H. Moore, Jr. *Air Transport*, Vol. 5, No. 4, April, 1947, p. 46.

The fire hazard from magnesium used in aircraft should be considered in aircraft design on a weight-vs.-safety basis.

Remarks on the Extinguishing of Magnesium Fires. E. Nachtigall. (*I.G. Farbenindustrie, Research Report No. 120*, 1943.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No.GDC 9/20T.* 5 pp., figs.

Flight Technique

Exposure—the Key to Flight Safety. Ralph S. Johnson. *Air Transport*, Vol. 5, No. 4, April, 1947, pp. 24–26, figs.

The expression "accident prevention" should be changed to "exposure elimination," because a potential accident exists when an exposure is continually tolerated. In order to minimize or eliminate an exposure it may be necessary to change or improve equipment, procedure and methods, or crew techniques and coordination. A common cause of accidents, circling too low when preparing to land, is discussed.

"Buzzing" Is Bad Business. Ralph S. Johnson. *Air Transport*, Vol. 5, No. 5, May, 1947, pp. 38, 39, 91, diagrs.

A discussion of improvements in landing procedure which must be adopted for all-weather straight-in landing technique. Circling should be discontinued for reasons of safety, economy, the increasing speed of aircraft, and the density of airport traffic.

Flight Testing and Performance

Effect of Wind Gradient on Glide and Climb. Bernard Etkin. *Journal of the Aeronautical Sciences*, Vol. 14, No. 6, June, 1947, pp. 365–367, figs. 3 references.

The problem of an aircraft flying through a head wind that increases with altitude is examined. The equations of motion are set and solved for flight at constant air speed in a wind that varies linearly. It is found that to fly under these conditions the angle of attack must be quickly adjusted to a steady value, and that the flight is subsequently at constant attitude, angle of attack, and elevator angle. The path is parabolic, the glide being extended and the climb contracted. Graphs are given of glide characteristics for a typical light aircraft.

Some Considerations of the Lateral Stability of High-Speed Aircraft. Leonard Sternfield. *U.S., N.A.C.A., Technical Note No. 1282*, May, 1947. 52 pp., figs. 4 references.

The effect of various parameters on the combination of the directional-stability derivative and the effective-dihedral derivative required for lateral-stability boundaries was determined by varying one parameter while the others maintained specified basic values. It was found that an airplane with a high wing loading designed for high-speed and high-altitude flight would be laterally stable if the moments of inertia, the location of the

principal longitudinal axis of the aircraft, and the value of the damping-in-roll derivative were properly selected.

Flight Tests on Static and Dynamic Directional Stability and Their Rate of Influence. I. Schmidt. (*Dornier-Werke, G.m.b.H., Do/VB/Re/3015/I,* November, 1942.) *U.S., Army Air Forces, Translation No. F-TS-921-RE,* April, 1947. 33 pp., illus. 9 references.

A yawing moment was induced on a Dornier Do 217 and Do 18 by attaching brake parachutes to the wing tips. Measurements were made of the control forces required to maintain stability both with fixed and with free rudder.

Flight Polar Measurement Test Methods, Evaluation, Corrections and Reduction. Rudolf Schmidt. (*Jahrbuch der Deutschen Luftfahrtforschung,* 1942, pp. I173–I185.) *Cornell Aeronautical Laboratory, Buffalo,* May, 1947. 45 pp., figs. 12 references.

Modern aircraft require that corrections be made for the influence of acceleration forces on the airplane when making these measurements. The effect of acceleration on the pendulum used to measure the angle with the horizon is calculated and plotted. The practical application of various methods is given, together with methods for reducing the data to other operating conditions.

Device for the Investigation of Coupled Oscillations, Particularly for the Investigation of the Dynamic Behavior of Aircraft With and Without Automatic Control. H. Temme. (*Deutsche Forschungsanstalt für Segelflug, Report No. 26,* March 13, 1942.) *Cornell Aeronautical Laboratory, Buffalo,* March, 1947. 5 pp., fig. 6 references.

The motion of an aircraft about its axis is represented by the turning motions of a system of galvanometers. The moments of inertia are given by discs on the shafts of this equivalent system. Electric current introduced into the windings produces moments proportional to the moments acting on the aircraft. An oscillograph for each axis permits the recording of behavior in flight.

Flight Tests of a Double-Hinged Horizontal Tail Surface with Reference to Longitudinal-Stability and -Control Characteristics. Carl M. Hanson and Seth B. Anderson. *U.S., N.A.C.A., Technical Note No. 1224,* May, 1947. 27 pp., illus.

The flight characteristics were generally satisfactory. There was unsatisfactory damping of longitudinal oscillations and large forward movement of the stick when trimming to low speeds. The choice of elevator floating characteristics as the trimmer is moved depends on conflicting requirements for control in wave-off, control in stall recovery, and ability to trim to low speeds, as opposed to the requirement for sufficient elevator-control power in landing.

Determination of the Magnitude of the Guide-Beam Control Constant for the Do-17 M Without Gyro Pilot. R. Schubert. (*Peenemünde, ZWB/PA/86/36,* August, 1940.) *U.S., Army Air Forces, Translation No. F-TS-1082-RE,* March, 1947. 6 pp., figs.

Stability range and magnitude for lateral signal-beam constants are determined mathematically for the Do-17 M, two-engined standard bomber. Time constants for the oscillation magnitude are tabulated. Graphs showing stability range of the guide beam are included.

Some Considerations on 2 Engines Vs. 4. *Aircraft* (Melbourne), Vol. 25, No. 7, April, 1947, pp. 28, 42.

Analysis of V-G Records from the SNJ-4 Airplane. M. Wilkerson and S. A. Bennett. *U.S., N.A.C.A., Memorandum Report No. L5L06 (Wartime Report No. L-578),* December, 1945. 12 pp., figs. 1 reference.

Influence of Loading Condition on Piloting Technique for Spin Recovery for Pursuit Airplanes. H. A. Soulé and Oscar Seidman. *U.S., N.A.C.A., Restricted Bulletin (Wartime Report No. L-461),* June, 1942. 8 pp. 7 references.

Flight Tests of F2A-2 Airplane with Full-Span Slotted Flaps and Trailing-Edge and Slot-Lip Ailerons. Joseph W. Wetmore and Richard H. Sawyer. *U.S., N.A.C.A., Advance Restricted Report No. 3L07 (Wartime Report No. L-272),* December, 1943. 44 pp., illus. 5 references.

Wind-Tunnel Investigation of a Plain Aileron with Thickened and Beveled Trailing Edges on a Tapered Low-Drag Wing. Paul E. Purser and John W. McKee. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-526),* January, 1943. 51 pp., figs.

Observations of Compressibility Phenomena in Flight. Richard V. Rhode and H. A. Pearson. *U.S., N.A.C.A., Advance Confidential Report No. 3D15 (Wartime Report No. L-417),* April, 1943. 41 pp., illus. 5 references.

Flight Tests of Various Tail Modifications on the Brewster XSBA-1 Airplane. III—Measurements of Flying Qualities with Tail Configuration 3. H. L. Crane and J. P. Reeder. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-599),* July, 1944. 77 pp., illus. 3 references.

Wind-Tunnel Study of the Effects of Propeller Operation and Flap Deflection on the Pitching Moments and Elevator Hinge Moments of a Single-Engine Pursuit-Type Airplane. H. R. Pass. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-411),* July, 1942. 62 pp., figs. 22 references.

Tapered Wings, Tip Stalling, and Preliminary Results from Tests of the Stall-Control Flap. Eastman N. Jacobs. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-296),* November, 1937. 27 pp., figs. 11 references.

Full-Scale Tunnel Investigation of the Control and Stability of a Twin-Engine Monoplane with Propellers Operating. Harold H. Sweberg. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-425),* November, 1942. 64 pp., illus. 16 references.

Fuels

Testing Volatility of Today's Fuels. R. J. Clark and R. M. Adams. *Air Transport,* Vol. 5, No. 4, April, 1947, pp. 47–49, illus.

A simple method of testing the performance of postwar high-octane fuels. Methods of correction for the malfunctioning they may cause are given.

Gliding and Soaring

Free Motion of a Stable Glider in an Atmosphere of Variable Density. W. J. Duncan and W. J. Scull. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2081,* March 25, 1941. 13 pp., figs. 6 references. British Information Services, New York. $0.75.

Where the density of the atmosphere is a function of the altitude it is shown that the influence of the fall of the density with the altitude is to reduce the steepness of the glide path and to increase the glide speed above that corresponding to the constant

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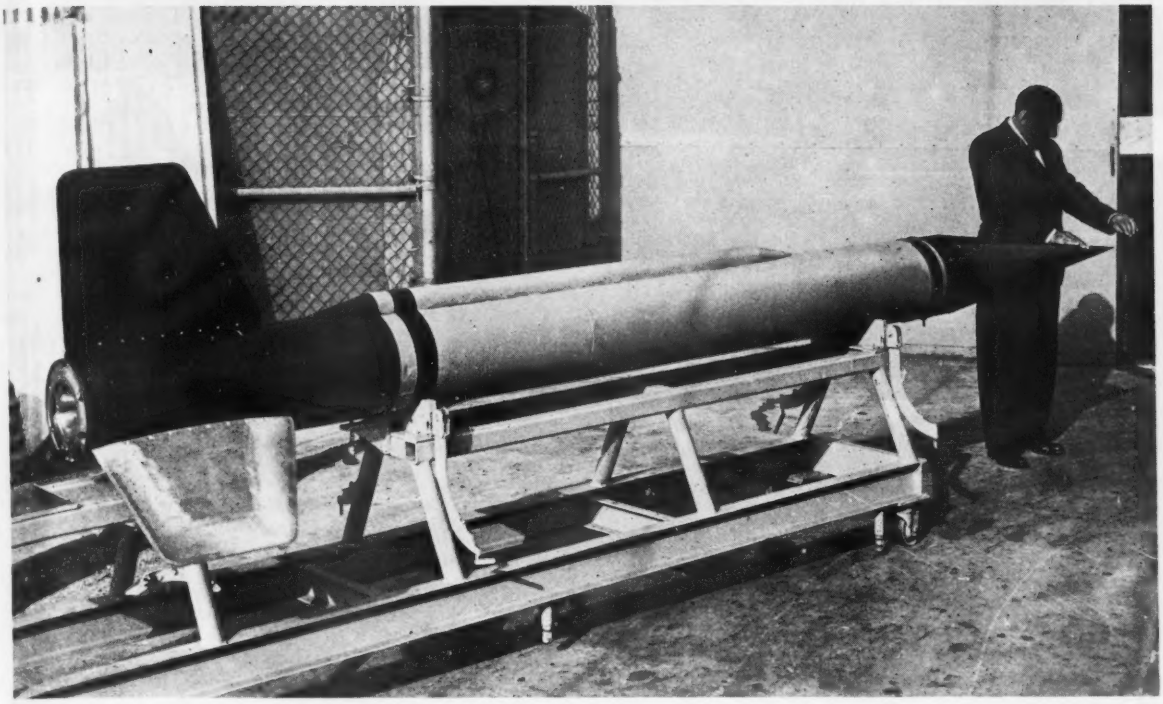


The WAC-B rocket, designed and developed by California Institute of Technology, the sheet-metal motors for which were made by Solar Aircraft Company.

equilibrium value of the indicated air speed. The detailed solution is obtained by a step-by-step method, in which the analytical solution is used within each interval and some variables are given their mean values for the interval, thus reducing the number of steps required.

Best Air Speeds for Thermal Cross-Country Flights. H. Neubroch. *Sailplane and Glider* (London), Vol. 15, No. 1, January, 1947, pp. 2–4, figs.

The best gliding speed for maximum distance between thermals will always be greater than the best gliding speed for maximum distance in still air by an amount proportional to the rate of lift experienced in the thermals.

Best Air Speeds. G. O. Smith. *Sailplane and Glider* (London), Vol. 15, No. 3, March, 1947, pp. 2, 3, figs.

Proposes calculation of best air speeds on the assumption of downdraft between thermals in order to reach new thermal with minimum loss of altitude.

Convection and the Soaring Pilot. I. H. Neubroch. *Sailplane and Glider* (London), Vol. 15, No. 4, April, 1947, pp. 2, 3.

The "Krajanek" (ZLIN-24). T. Rex Young. *Sailplane and Glider* (London), Vol. 15, No. 1, January, 1947, pp. 5–7, illus.

The "Krajanek" being manufactured by Zlinavion at Zlin, Czechoslovakia, is a conventional high-wing, intermediate training glider of wood construction with good stability, ease of handling, and simplicity in production and assembly. Wing span is over 39 ft.; gross weight, 198 lbs.; wing loading, 3.257 lbs. per sq.ft.; and minimum speed, 28.5 m.p.h.

The Broburn Wanderlust. *The Aeroplane Spotter*, Vol. 8, No. 185, April 19, 1947, p. 77, illus.

The sailplane produced by Broburn Sailplanes Ltd. (England), is a wooden single-seater with a cantilever shoulder wing covered with plywood from the leading edge to the spar and with fabric to the trailing edge. A fabric-covered cut inner tube provides an inflated shock absorber for the skid.

Guided Missiles

Control of the Rudder Position Without Feedback. Schroeder. (*Peenemünde, ZWB/SAG/Re/87/7*, July 4, 1939.) *U.S., Army Air Forces, Translation No. F-TS-1085-RE*, March, 1947. 2 pp.

The behavior of the rudder mechanism which does not have a rudder position feedback but instead a direction indicator that also records rotary acceleration, is examined in order to determine under what conditions pitching caused by oscillation of the missile becomes dangerous.

Homing Missiles: The Design and Development of Navy Bombs That Can Find and Hit Targets by Self-Contained Radar Control. *Army Ordnance*, Vol. 31, No. 162, May-June, 1947, pp. 494, 495, illus.

High Angle Bombs. L. O. Grondahl. *Army Ordnance*, Vol. 31, No. 162, May-June, 1947, pp. 503–505, illus.

The Azon, known as the VB-3, one of the high angle bombs developed by the Gulf Research and Development Company, is a direct-sight, radio-controlled bomb which, when dropped from 15,000 ft., has a range error of approximately 45 ft. and an error in azimuth of less than 15 ft.

A New Weapon (The Fairey "Stooge" Guided Missile). *The Aeroplane*, Vol. 72, No. 1871, April 18, 1947, pp. 383, 384, illus. (Cf. AER 6/47:43.)

The Fairey Guided Missile. *The Engineer*, Vol. 183, No. 4760, April 18, 1947, pp. 332, 333, illus.

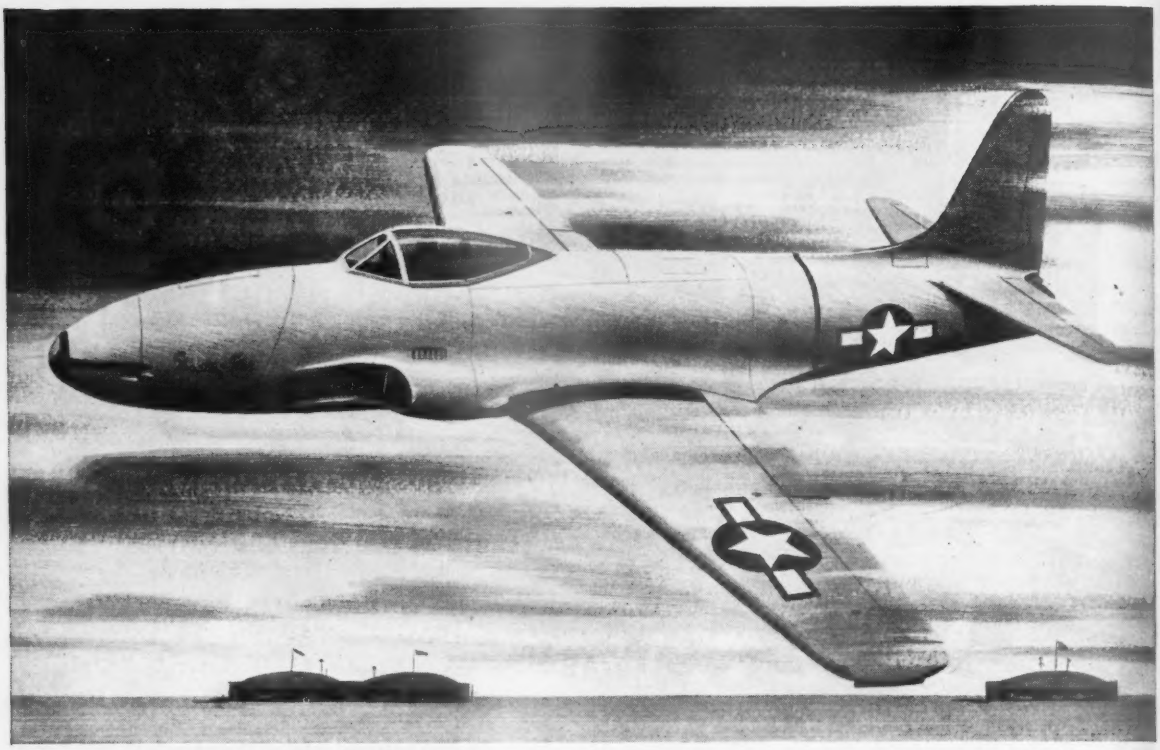
Ice Prevention

The Göttingen Dividing-Strip De-Icer and the Göttingen Cabin Wall Heat Lining. Ritz and Hentrich. (*Göttingen, Aerodynamische Versuchsanstalt, ZWB/AVAG/42/7/7*, July 15, 1942.) *U.S., Army Air Forces, Translation No. F-TS-2606-RE*, April, 1947. 6 pp., illus.

Utilizing heat conducting buna, Continental A.G. developed an electrically operated surface deicer with a dividing strip along the leading edge of the wing. Heating the leading edge for $^1/_2$ min. in intervals of about 3 min. effects casting off of the ice crust along the dividing strip. The buna lining can also be used for heating cabin walls at high altitudes.

Protection of Aircraft Against Ice. J. K. Hardy. *Royal Aeronautical Society, Journal*, Vol. 51, No. 435, March, 1947, pp. 271–290, illus., Discussion, pp. 290–305. 11 references. (Cf. AER 3/47:66.)

Continuous heating of the critical parts of the aircraft by heated air is the most common method of protecting against ice



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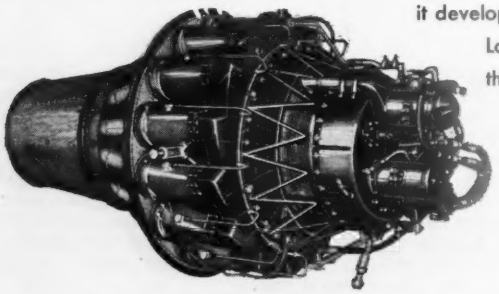

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formation. After consideration of the theoretical aspects of the problem, the various methods that have been tried or proposed are described and evaluated. Heating of the wing leading edge and the tail assembly by warm air and exhaust gas is explained in detail. Stress is laid on the problems presented by the powerplant assembly.

Kinetic Temperature of Wet Surfaces a Method of Calculating the Amount of Alcohol Required to Prevent Ice, and the Derivation of the Psychrometric Equation. J. K. Hardy. *U.S., N.A.C.A., Advance Restricted Report No. 5G13* (*Wartime Report No. A-8*), September, 1945. 22 pp., tables. 2 references.

An Analytical Investigation of Thermal-Electric Means of Preventing Ice Formations on a Propeller Blade. Richard Scherrer. *U.S., N.A.C.A., Advance Confidential Report No. 4H31* (*Wartime Report No. A-17*), August, 1944. 56 pp., figs. 15 references.

Theory of Propeller De-Icing. Franz Eder. (*Technische Berichte, ZWB/FB/RE/11/5S123*, May, 1944.) *U.S., Army Air Forces, Translation No. F-TS-940-RE*, March, 1947. 20 pp., figs. 12 references.

The correct temperature for deicing propellers is calculated on the basis of the known heat exchange value for a flat plate and the known frictional temperatures of the laminary and turbulent flows of the boundary layer.

An Investigation of the Characteristics of Alcohol-Distribution Tubes Used for Ice Protection on Aircraft Windshields. Richard Scherrer and Clair F. Young. *U.S., N.A.C.A., Advance Restricted Report No. 4B26* (*Wartime Report No. A-20*), February, 1944. 15 pp., illus. 2 references.

Icing Tests of Aircraft-Engine Induction Systems. Leo B. Kimball. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. W-97*), January, 1943. 57 pp., illus. 6 references.

Preliminary Investigation and Design of an Air-Heated Wing for Lockheed 12A Airplane. Lewis A. Rodert and Richard Jackson. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. A-34*), April, 1942. 21 pp., illus. 3 references.

Measurement of Free Water in Cloud Under Conditions of Icing. J. K. Hardy. *U.S., N.A.C.A., Advance Restricted Report No. 4I11* (*Wartime Report No. A-15*), October, 1944. 16 pp., illus. 5 references.

An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane. II—The Design, Construction, and Preliminary Tests of the Exhaust-Air Heat Exchanger. Richard Jackson. *U.S., N.A.C.A., Advance Restricted Report No. 5A03a* (*Wartime Report No. A-25*), February, 1945. 33 pp., illus. 11 references.

Analysis of a Thermal Ice-Prevention System for Wing Leading-Edge Landing-Light Installations. Wesley H. Hillendahl. *U.S., N.A.C.A., Advance Restricted Report No. 4A11* (*Wartime Report No. A-10*), January, 1944. 17 pp., illus. 3 references.

First-Stage Diffuser with De-Icing Device in BMW 003 A 2 Jet Engine. Kuemmel. (*Bayerische Motoren Werke A.G., BMW/TNDS-634/44*, December 2, 1944.) *U.S., Army Air Forces, Translation No. F-TS-2602-RE*, April, 1947. 2 pp., figs.

Design details of electrical heating elements in the cavities of the diffuser vanes. To ensure sufficient strength, the thickness of the vanes was increased from 1.5 to 2.2 mm.

Investigations on Ice Formation in the Power Unit of the FZG 76. K. Eisele and E. Schäfer. *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/5506T.* 2 pp.

Flight tests showed that ice did not form in the inlet valve of the thrust tube. Ice formed in the pitot tube and could have resulted in failure of the governor.

A Description of the Ju 88 Airplane Anti-Icing Equipment. Lewis A. Rodert and Richard Jackson. *U.S., N.A.C.A., Restricted Bulletin* (*Wartime Report No. A-39*), September, 1942. 10 pp., figs. 1 reference.

Instruments—General

Investigation of the Problem of the Deviation of a Free Gimbal-Suspended Gyro Under the Effect of Nutation. F. Weideman and K. Seebach. (*Deutsche Forschungsanstalt für Segelflug*, July, 1944.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/1447T.* 26 pp., figs. 1 reference.

Experiments showed that the outer frame of a free, gimbal-suspended gyro deviated under the effect of nutation. This is the result of the nonsymmetry caused by the inclined position of the inner frame. Theoretical investigation showed that the deviation is fundamentally associated with nutation. The influence of the separate factors on the deviation was calculated for small amplitudes of nutation. Means of avoiding the deviation are suggested.

Instruments, Engine

Synchroscopes for Multi-Engined Aircraft. V. C. Hunt. *Aircraft Engineering*, Vol. 19, No. 217, March, 1947, p. 95, diagrs.

A three-phase electric tachometer indicator has been developed which compares the frequency of two or more tachometer generators before they have been translated into an indicated r.p.m. It consists of a small synchronous motor driving a magnetic drag unit. The two frequencies are used to operate a beat frequency indicator, the pointer of which rotates in proportion to the difference in speed. This makes it possible to phase the engines of a multiengined aircraft in spitè of the permissible tolerance on each of the tachometer indicators.

Instruments, Flight

Determination of Airplane Thermometer Recovery Factors in Flight. H. W. Sibert. *Journal of the Aeronautical Sciences*, Vol. 14, No. 6, June, 1947, pp. 364, 367.

A formula which is apparently new is derived for the airplane thermometer recovery factor as a function of the free-stream Mach Number. A semigraphical method based on this formula is then outlined for determining the thermometer recovery factor by flying the airplane at various free-stream Mach Numbers at a constant altitude.

The Measurement of Air Temperatures in High-Speed Flight. E. Eckert and W. Weise. (*Braunschweig, Luftfahrtforschungsanstalt Hermann Göring, Bericht.*) *Gt. Brit., Ministry of Supply, R.T.P. Translation No. 2570.* 7 pp., diagrs. 4 references. Durand Reprinting Committee, California Institute of Technology, Pasadena. $0.35.

The flight speed can be calculated if the temperature of the air and the temperature rise due to the motion of the aircraft are known. The design and calibration of a bent-tube resistance thermometer for this purpose is described. The instrument minimizes inherent instrument inertia.

New Stall Warning Indicator. *Aviation Maintenance & Operations*, Vol. 7, No. 6, May, 1947, pp. 45, 90, 92, illus. (Cf. AER 3/47:67.) Description of the Greene stall-warning indicator manufactured by the Safe Flight Instrument Corporation.

Quit Your Stalling. William S. Friedman. *Air Force*, Vol. 30, No. 5, May, 1947, pp. 56, 57, illus. (Cf. preceding abstract.)

Flight Investigation of a Stall-Warning Indicator for Operation Under Icing Conditions. Alun R. Jones and John A. Zalovcik. *U.S., N.A.C.A., Restricted Bulletin* (*Wartime Report No. L-503*), July, 1942. 13 pp., illus. 1 reference.

Relative Airflow Indicators. A. York Bramble. *Sailplane and Glider* (London), Vol. 15, No. 2, February, 1947, pp. 2–5, figs.

Two wind vanes register the yawing and pitching components of the direction of relative airflow. A concave pressure plate indicates the approximate relative air speed.

Cathode Tube Improves Compass (Minneapolis-Honeywell Cathotrol). *Aviation*, Vol. 46, No. 5, May, 1947, pp. 80, 81, illus. (Cf. AER 5/47:47.)

A Simplified Chart for Determining Mach Number and True Airspeed from Airspeed-Indicator Readings. Donald D. Baals and Virgil S. Ritchie. *U.S., N.A.C.A., Restricted Bulletin* (*Wartime Report No. L-473*), March, 1943. 8 pp., chart. 2 references.

Insurance, Safety, and Rescue

Accident Figures. *Airports & Air Transportation* (London), Vol. 1 (N.S.), No. 46, March, 1947, pp. 441, 442. A statistical analysis of air safety in the United Kingdom from 1925 to 1946.

Safety Around the World. Leon William Johnson. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 58–61, illus. An outline of the A.A.F. ground safety program.

Arctic Rescue. James W. Moreau. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 62–67, illus.

Thoughts on the Independent Air Safety Board. Jerome Lederer. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 30, 31, illus.

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Safety and the Scheduled Airlines. Robert Ramspeck. *Tennessee Air Progress*, Vol. 2, No. 1, Spring, 1947, pp. 7–10, illus.

Landing Gear

Ground Rolling Resistance of Airplane Landing Gears. Frank and Kranz. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/-1037*, March, 1939.) *U.S., Army Air Forces, Translation No. F-TS-960-RE*, April, 1947. 35 pp., illus. 10 references.

Rolling resistance is a decisive factor in the take-off run on unsurfaced terrain. No accurate criteria could be found to judge the resistance of an unknown field. On untreated ground the rolling resistance is increased when the tire pressure is increased and a proportional damage is done to the field. Detailed diagrams of the recording dynamometer used in the tests are given.

Ground Pressure Tests on Landing Skis. J. Sydow. (*Deutsche Luftfahrtforschung, ZWB/UM/667*, April, 1942.) *U.S., Army Air Forces, Translation No. F-TS-920-RE*, March, 1947. 11 pp., illus.

Stress Tests on the Landing Gear of the Nose-Wheel Airplane Me 262 in Landing. Partial Report No. A[1]—Investigation on the Tangential Forces at the Damped Shock on a Blow-Impact Equipment. G. Schmitz. (*ZWB/UM/Re/1391*, October 13, 1944.) *U.S., Army Air Forces, Translation No. F-TS-966-RE*, April, 1947. 14 pp., figs. 1 reference.

Lubrication and Lubricants

Development of an Oil-Testing Machine. H. Wenzel. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/326*, April 30, 1935.) *U.S., Army Air Forces, Translation No. F-TS-929-RE*, February, 1947. 5 pp., illus.

The floating frame of the ball bearing at the lower end of a vertical shaft is connected to a tension dynamometer. The indicated friction moment varies in inverse proportion to the continuity of the oil film. Bearing load and temperature can be adjusted, arbitrarily simulating the operating conditions of high-performance engines.

Testing of a Laboratory Procedure for the Oxidation of Lubricating Oils. K. Mayer-Bugstroem. (*Deutsche Versuchsanstalt für Luftfahrt, ZWB/FB/381*, June 20, 1935.) *U.S., Army, Air Forces, Translation No. F-TS-926-RE*, April, 1947. 20 pp., figs. 5 references.

Oil Purification, Filtration and Reclamation. I—Purification. II—Filtration. Brian Corrigan. *Aviation Maintenance & Operations*, Vol. 7, Nos. 5, 6, April, May, 1947; pp. 28, 29, 88, 90, 92, illus.; pp. 32, 33, 90, diagrs.

Maintenance

Servicing the Miles Aerovan. II—Inspection Operations and Routine Adjustments. S. Cooper. *Aircraft Engineering*, Vol. 19, No. 217, March, 1947, pp. 101–107, diagrs. (Cf. AER 5/47:47.)

Reducing the Maze of Ground-Service Units. W. L. Flinn *Air Transport*, Vol. 5, No. 5, May, 1947, pp. 29–32, diagrs.

Multiple Disc Brakes; Trouble Servicing. *Canadian Aviation*, Vol. 20, No. 4, April, 1947, pp. 66, 70, 88, illus.

Line Maintenance of the 3000-(Plus)-Hp. Wasp Major. Fowler Barker. *Air Transport*, Vol. 5, No. 4, April, 1947, pp. 27–30, illus.

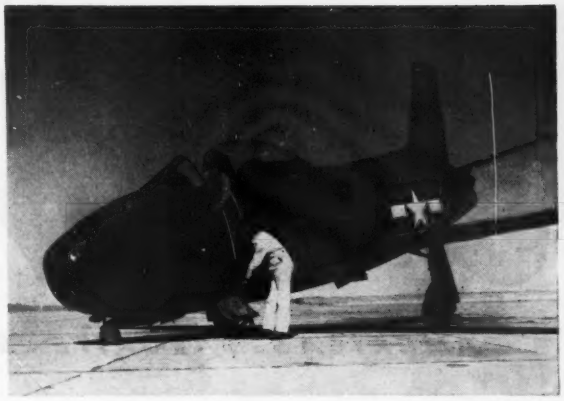
Materials—General

Fasteners for Aircraft. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 35–50, illus. A detailed description of the bolts, nuts, screws, and rivets commonly used in aircraft construction.

Materials—Metals and Alloys

A Metallurgical Investigation of Large Forged Discs of Low-Carbon N-155 Alloy. Howard C. Cross and J. W. Freeman. *U.S., N.A.C.A., Technical Note No. 1230*, April, 1947. 53 pp., illus. 3 references.

The properties of large discs of low-carbon N-155 alloy in both the as-forged and water-quenched and aged conditions were determined by means of stress-rupture and creep tests for periods up to about 2,000 hours at 1,200°, 1,350°, and 1,500°F. The results of short-time tensile tests and impact tests, and time-total deformation characteristics are included.



The Navy's XFJ-1, built by North American Aviation, Inc., incorporates a "bending nose gear" which enables the plane to "kneel down" to facilitate handling and stowage on aircraft carrier decks.

Compressive-Strength Comparisons of Panels Having Aluminum-Alloy Sheet and Stiffeners with Panels Having Magnesium-Alloy Sheet and Aluminum-Alloy Stiffeners. Norris F. Dow, William A. Hickman, and Howard L. McCracken. *U.S., N.A.C.A., Technical Note No. 1274*, April, 1947. 36 pp., illus. 6 references.

The composite magnesium-alloy (FS-1H), aluminum alloy (245-T) panels have a higher structural efficiency and buckling load than the 245-T aluminum-alloy compression panel with Z-stiffeners if the stiffeners are widely spaced. If the stiffeners are closely spaced or if the panels have ideal proportions, the structural efficiencies are nearly the same except in a small range of loading conditions in which the 245-T aluminum-alloy panels have a slightly higher efficiency.

Aluminum Pistons for Automobile and Aircraft Engines. L. E. Bogue and Norman Hoertz. *U.S., Field Information Agency, Technical, Final Report No. 602*, December 10, 1945. 5 pp. British Information Services, New York. $0.20.

German piston designs were found to be similar in every respect to those used in the United States. Aluminum alloys in regular production, containing 17 to 21 per cent silicon, were found.

Tests on Bearing Metals in Hydraulic Clutches. Klar. (*Daimler-Benz, Test Report Ver/Re/161-211*, July 7, 1939.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 11/125T.* 3 pp. Evaluation of diamond bronze, lead bronze (Admos), Braunschweig lead bronze, and Panbronze as hydraulic clutch bearings.

Materials—Plastics and Plywood

Compression Tests of Six Curved Paper-Base Plastic Panels with Outward-Acting Normal Pressure. Evan H. Schuette, Norman Rafel, and Charles V. Dobrowski. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-280)*, September, 1944. 12 pp., illus.

Close Contouring of Honeycomb Sections. Robert Young. *Modern Plastics*, Vol. 24, No. 9, May, 1947, pp. 140–141, illus.

Honeycomb made of cloth impregnated with phenolic resin and formed in a column structure was developed by The Glenn L. Martin Company and is produced by the United States Plywood Corporation. This material can be contoured to an accuracy of $^{3}/_{1,000}$ in. by a specially designed jig that employs a compound saw blade as a rasp.

Mechanical Tests of Macerated Phenolic Molding Material. William N. Findley. *U.S., N.A.C.A., Advance Restricted Report No. 3F19 (Wartime Report No. W-99)*, June, 1943. 57 pp., illus. 5 references.

Compression Tests on Plywood Skins. *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 13/10.* 4 pp., figs.

Report of Discussion at the Adhesive Conference at Detmold on February 9, 1944. *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 16/424T.* 4 pp.

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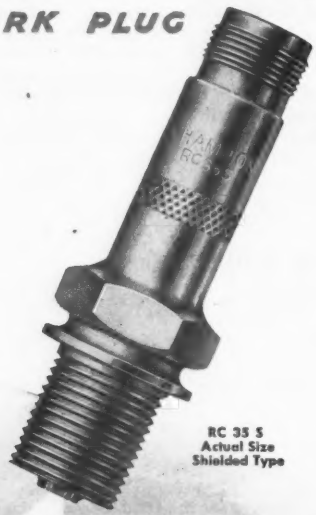

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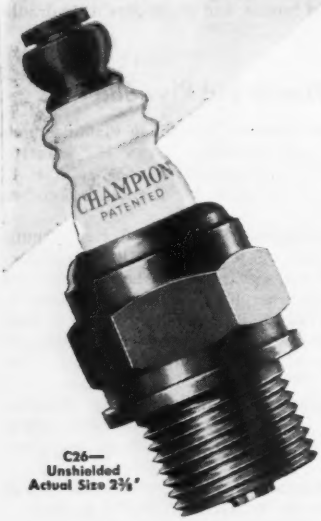

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Materials—Protective Coating

Final Report on Coating Media (Varnishes) Tested by the DVL During the Year 1938. H. Groeber. (*ZWB/UM/377*, April 25, 1939.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/5095T.* 36 pp.

Testing of Varnish Removers. H. Giehman. (*ZWB/UM/462.*) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/5032T.* 3 pp.

Mathematics

Gauss' Elimination Method for Solving Linear Equation Systems. R. Zurmühl. (*Darmstadt, Technische Hochschule, ZWB/UM/774*, May, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1059-RE*, January, 1947. 15 pp.

A Note on Stability Calculations and Time Lag. Seymour Sherman. *Quarterly of Applied Mathematics*, Vol. 5, No. 1, April, 1947, pp. 92–97. 19 references.

The application of the Cauchy-Sturm method to a discussion of the zeros of transcendental expressions such as $az^2 + bz + ce^{-z} + d$.

Mechanics

The Roll Link as the Basic Element of Plane Gear Drives; A Contribution to the Systematic Analysis of Transmission-Mechanisms. K. H. Sieker. (*Die Technik* (Berlin), Vol. 2, No. 1, January, 1947, pp. 29–35.) *The Engineers' Digest*, Vol. 4, No. 4, April, 1947, pp. 165–170, diagrs. 4 references.

Starting with the theorem that any movement in a plane with respect to another plane which is in a state of rest can be represented by two curves rolling on each other, the roll link, the skid link, and the slip link are developed. These elements are used to analyze and classify simple machines, transmission mechanisms, and gears.

Medicine

A Study of the Effect of Training in Slow Flight on Landing Performance. David Bakan, R. Y. Walker, and Seymour Wapner. *U.S., Civil Aeronautics Administration, Division of Research, Report No. 71*, April, 1947. 41 pp., tables.

Significant differences were not evident between the performances of experimental and control groups in terms of the available criteria. No systematic differences were indicated. The experimental data, however, did not indicate that the slow flight-training procedure in landing is less effective than conventional instruction.

The Changes in Pressure in the Peritoneal Cavity Produced by Sudden Deceleration of Experimental Animals. R. F. Rushmer. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 199–205, Discussion, pp. 205, 206, illus. 11 references.

Medical Care of Casualties in Long Distance Air Evacuation. Grace H. Stakeman. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 192–197, Discussion, pp. 197, 198.

The Physical Principles Involved in Pilot Comfort and Efficiency. Francis E. Randall and Donald I. Patt. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 184–189, Discussion, pp. 189–191.

Air Evacuation Activities. David N. W. Grant. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 177–181, Discussion, pp. 181–183, 191.

Evaluation of Certain Tests of Physical Fitness. Harvey M. Patt. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 169–175, tables. 5 references.

Occurrence of Bends, Scotomata and Hemianopsia at Altitudes Below 20,000 Feet. Charles S. Houston. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 165–168. 7 references.

The Influence of Cold upon the Efficiency of Man. Steven M. Horvath and Arthur Freedman. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 158–164, figs.

Arterial Oxygen Saturation at Altitude. Margaret Henson, David E. Goldman, and others. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 149–157, Discussion, pp. 157, 216, figs. 11 references.

Studies on Positive Pressure Respiration. III—Effect of Continuous Pressure Breathing on Arterial Blood Gases at High Altitude. Alvan L. Barach, Morris Eckman, and others. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 139–148, fig. 12 references.

An Electronic Warning Device for Oxygen Breathing Systems. Cornelius A. Tobias and William Siri. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 133–138, 164, illus. 7 references.

The Rate of Nitrogen Elimination from the Body Through the Lungs. Charles D. Stevens, Henry W. Ryder, Eugene B. Ferris, and Masahiro Inatome. *Journal of Aviation Medicine*, Vol. 18, No. 2, April, 1947, pp. 111–132, 168, figs. 17 references.

The Flight Surgeon; His Role in Student Pilot Training. Richard C. Cumming. *The Military Surgeon*, Vol. 100, No. 5, May, 1947, pp. 385–389.

Stormy Weather: Are We Overlooking That Vital Link Between the Dashboard and the Controls—the Pilot? *Flight*, Vol. 51, No. 2001, May 1, 1947, pp. 391–393.

Meteorology

The Development of a Method of Estimating and Forecasting Wind at 10,000 Feet over the North Atlantic. H. H. Lamb. *Ireland, Meteorological Service, Dublin, Technical Note No. 4 (Advance Issue)*, January 14, 1943. 31 pp., charts.

A reasonably accurate method of determining the wind-flow pattern by indirect means. Pilot balloon winds, pressures, and nephoscopic observations are plotted. Mean temperature of the air column is estimated from representative surface temperature and the corresponding adiabatic lapse rate. Allowance for variations of temperature lapse rate is made by the use of certain rules of thumb. Checks of similar charts for lower levels and the elimination of serious flight-time errors since 1941 indicate good agreement with actual conditions.

The Computation of Atmospheric Pressure at the 8 KM Level of Constant Air Density. Mariano Doporto. *Ireland, Meteorological Service, Dublin, Technical Note No. 1 (Advance Issue)*, January 11, 1943. 36 pp., figs.

A theoretical discussion of the air density variation in an atmosphere with a lapse rate independent of the height. This discussion indicates the existence of a second isopycnic layer at about 25 km. A method for computing pressures at the first or tropospheric isopycnic layer is suggested and the results obtained by these methods are checked with land and sea observations made with sounding balloons carrying Dines meteorographs or radiosondes.

Cell Motion in the Atmosphere. Mariano Doporto. *Ireland, Meteorological Service, Dublin, Technical Note No. 6 (Advance Issue)*, September 5, 1944. 62 pp., figs. 25 references.

XC-35 Gust Research Project: Characteristics of Vertical Drafts and Associated Vertical-Gust Velocities Within Convective-Type Clouds. A. I. Moskovitz. *U.S., N.A.C.A., Restricted Bulletin No. L5A03 (Wartime Report No. L-554)*, January, 1945. 11 pp., illus. 4 references.

The E-Stratum of Ionosphere Daily and Seasonal Fluctuations. Harnischmacher. (*ZWB/UM/Re/827*, October, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1101-RE*, April, 1947. 17 pp., figs.

Military Aviation

"A Proud and Imposing Record." *Aero Digest*, Vol. 54, No. 4, April, 1947, pp. 22, 23, 142, 143, 146, 147, illus.

A historical résumé of the growth of military aviation in the United States, with a compilation of the numbers of A.A.F. personnel for each year from 1917 to 1946.

Organization, Principles, and Practices of Inspection in the Japanese Army Air Force. *U.S., Army Air Forces, Intelligence Review No. F-IR-128-RE*, February, 1947. 197 pp.

Navigation

Aerologation. Robert Mansfield. *Air-Sea Safety*, Vol. 2, No. 4, April, 1947, pp. 39–47, figs.

The technique of computing an automatic pressure pattern route with the aid of radio and the aneroid altimeter. The method abandons great circle and rhumb courses to utilize optimum meteorological conditions.

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Air Weather Service Develops New Navigational System. *U.S., War Department, Release,* May 18, 1947. 3 pp.

The course is plotted to take advantage of favorable air currents. Even though this is frequently a deliberate deviation from the great circle route, it reduces flying time by 10 to 20 per cent in flights longer than 500 miles.

Parachutes

Furon Brake Parachutes. (*Phrix Co. Report,* December 20, 1944.) *Cornell Aeronautical Laboratory, Buffalo* May, 1947. 4 pp.

Fabric developed by the Furon Thread Company (Germany) is spun from the polycondensation products of aminocapron acids and caprolacta. In the cold state this product possesses extreme plastic deformability and can be stretched about 400 per cent. Sections of this material in the unstretched state were integrated between the supporting webs and the parachute lines. Tests showed that this substantially reduced the opening shock and permitted either higher speeds or reduction in the quantity of material used in the parachute.

Photography

The Latest Developments in Three-Dimensional Photography (The Maurice Bonnet Method). (*L'Illustration,* Paris.) *U.S., Army Air Forces, Translation No. F-TS-800-RE,* March, 1947, 5 pp., figs.

Resolving Power of Photographic Lenses. Konstantin Pestrecov. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 64–85, figs. 16 references.

Notes on Stereoscopy; The Human Eye as a Center of Perspective. H. C. Ryker. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 115–119, figs. 10 references.

The Kelsh Plotter. Harry T. Kelsh. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 121–126, illus.

Viewing Photography in Three Dimensions. Phillip S. Kistler. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 127–134, figs.

Tangential Distortion and Its Effect on Photogrammetric Extension of Control. John T. Pennington. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 135–142, figs. 1 reference.

The Determination of Tilt from Scale Check Lines. P. H. Underwood. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 143–155, figs.

Status of Aerial Photography of the United States (with Index Map.) U.S., Geological Survey. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 157–160.

Photogrammetric Practices in Switzerland. Edmond Staub. *Photogrammetric Engineering,* Vol. 13, No. 1, March, 1947, pp. 59–64.

Production—General

Investigation of Production Control and Organisation in German Factories. E. L. G. Robbins, R. Appleby, and others. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 537, Item No. 31.* 11 pp. British Information Services, New York. $0.55.

Investigation of Production Control and Organisation in German Factories. Appendix—Production Control in the Heinkel Aircraft Organisation. Karl Kieffer. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 537 (Appendix), Item No. 31.* 51 pp. British Information Services, New York. $1.45.

Model Shop-Layouts. *Aircraft Production,* Vol. 9, No. 102 April, 1947, pp. 142–144, illus. A method of establishing machine and equipment locations by the use of small three-dimensional models.

Production Methods

Laminar-Flow Wing Construction. S. G. Poulsen. *Aircraft Production,* Vol. 9, No. 101, March, 1947, pp. 88–96, illus.

The Armstrong Whitworth A.W. 52 is a tailless prototype with 90-ft. wing span and is powered by two Rolls-Royce Nene gas-turbine engines. Air intake from wing surfaces, which discharges into the engine combustion chambers, controls the boundary layer for the alleviation of premature tip-stall caused by sweepback. Laminar flow up to 55 per cent chord is insured by a profile accuracy tolerance of 0.002 in./2 in. The 16 standard wire gage skins are held to contour while the supporting structure of rolled-section spanwise members is being attached by means of countersunk rivets. Multiple clamps on curved beams of the assembly fixture hold the sections during riveting. Projecting portions of the countersunk rivet heads are milled off to the tolerance of 0.002 in. Alignment of contour boards is checked by a telescope on a sighting base. Litholofting is used to reproduce full-scale layouts. A fabric covering protects the surface of the skin panels during production.

Profile Machining. N. J. Cooke. *The Engineer,* Vol. 183, No. 4760, April 18, 1947, diagrs. (Extended abstract of a paper.) Description of shop technique used in skiving small parts to close tolerances on capstan or automatic lathes.

Thread Rolling Process for Finned Radiator Tubes. A. B. Nodine. *U.S., Field Information Agency, Technical, Final Report No. 582,* February 5, 1946. 3 pp., figs. British Information Services, New York. $0.20.

Comparison of Use of Mixed Structural Materials and Fabric Covering to All-Metal Construction for Personal Aircraft from a Manufacturing Viewpoint. Walter C. Jamouneau. *Preprint, S.A.E. National Personal Aircraft Meeting,* Wichita, May 1–2, 1947. 6 pp.

Plant space and equipment requirements and material and labor costs are less for all-metal construction, and smaller inventory investments are achieved. More exacting inspection procedures are required for composite construction, which lends itself more readily, however, to subcontracting and regional-plant operations because hand labor can be used, eliminating duplicate installations of mechanized equipment. Actual fuselage structure material cost and labor requirements are analyzed briefly.

A Review of Production Problems in Relation to Aircraft Design. C. E. Fielding. *The Aeroplane,* Vol. 72, No 1873 May 2 1947, pp. 452–455, Discussion, pp. 455, 456, illus (Extended abstract of a paper.)

Report on Bristol Type 167. IV. *Aircraft Production,* Vol. 9, No. 103, May, 1947, pp. 167–174, illus. (Cf AER 6/47:51.)

A full description of the construction and assembly technique of the spar assembly, the ribs, and the wing as a whole. Emphasis is given to machining the longerons, tolerances, and special tools.

Piston-Ring Production. J. A. Oates. *Air raft Production,* Vol. 9, No. 103, May, 1947, pp 192–199, illus.

The developments in design and materials, foundry procedure, machining, special treatment, and inspection of the piston rings produced by Wellworthy Piston Rings, Ltd.

Production of Hydraulic Equipment. I—The Liquid Spring: Dowty Machining Technique for Forming Deep Bores and Accurate Threads in High-Tensile Steel Components. *Aircraft Production,* Vol. 9, No. 103, May, 1947 pp. 163–166, illus.

Inert-Gas-Shielded Arc Welding for Difficult-to-Weld Materials. H. R. Clauser. *Materials & Methods,* Vol. 25, No. 4, April, 1947, pp. 86–90, illus. Information regarding applications of this process, welding costs, design considerations, and welding techniques.

Causes and Prevention of Welding Defects. Frederick S. Dever. *The Iron Age,* Vol. 159, No. 16, April 17, 1947, pp. 50–53, illus.

Defects in welding can usually be traced to preventable faults in technique or procedure, and steps should be taken to assure high-grade fabrication by competent workmen. Common causes of defects in arc welding, gas welding, atomic hydrogen welding, and spot welding are outlined.

Atomic Hydrogen Welding of Stainless Sheet. George Richardson *The Iron Age,* Vol. 159, No. 19, May 8, 1947, pp. 72–74, illus

It was found that hydrogen was the most suitable medium for protecting the underside of welds made in austenitic stainless steel. A special collar fixture clamp encircles the crossover tubes of the outer combustion chamber assembly of the G-E type 1-16 gas turbine and feeds a small supply of hydrogen along the wall of the tube to the weld joint at the open end cylinder. The welding is done from the inside of the cylinder. Longitudinal square groove butt joints can be clamped to a plate of mild steel and tacked with a carbon pencil. This causes a slight upsetting

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which, during welding, permits sufficient hydrogen to seep beneath the joint to protect the weld.

The Welding of Stainless Steel for Jet Propulsion. E. J. DeWitt and F. J. Lammers. *The Welding Journal*, Vol. 26, No. 4, April, 1947, pp. 320–323, illus.

In the production of tight tolerance gas-turbine nozzles, distortion was caused by accumulated creep between blade and band subassemblies that had been tacked but not solid welded. This necessitated two operators working on opposed portions of the blade-band joints, moving at 45° intervals until the entire subassembly was tacked down. The occurrence of expansion and contraction in areas being solid welded was found to be distributed more uniformly by allowing more time for the welding. A manually controlled submerged arc was used. Multiple welds gave the best control of radial tolerances.

Effects of Flux in Welding Stainless Steel. G. Richardson. *The Iron Age*, Vol. 159, No. 18, May 1, 1947, pp. 42–46, illus.

The use of a flux with high borate content in atomic hydrogen welding produced a eutectic condition that contributed to failure. Hydrogen backing should be used instead of flux, particularly when welding over welds and in repair work.

Optimum Welding Conditions and General Characteristics of Spot Welds in Magnesium Alloy Sheet. W. F. Hess, T. B. Cameron, D. J. Ashcraft, and F. J. Winsor. *The Welding Journal*, Vol. 26, No. 5, May, 1947, pp. 268-s–282-s, figs. 18 references.

Spotwelding in Aircraft Manufacture. Frederick S. Dever. *Materials & Methods*, Vol. 25, No. 5, May, 1947, pp. 92–95, illus.

Production Applications for Inert Gas Shielded Arc Welding. H. T. Herbst. *The Welding Journal*, Vol. 26, No. 5, May, 1947, pp. 410–418, illus.

Electronic Heating Applied to the Thermal Treatment of Wood, Rubber, and Plastic Materials. M. Doucerain. (*Société Française des Electriciens, Bulletin*, Vol. 6, No. 62, October, 1946, pp. 498–509.) *The Engineers' Digest*, Vol. 4, No. 4, April, 1947, pp. 177–180, diagrs.

The first part of the article is a theoretic discussion of the electronic heating of material. The case of a perfect and an imperfect thermal insulator is considered. The second section develops the formulas for computing the quantity of heat required in a given operation and the corresponding power required. The third section treats of the practical application of the theory to the drying of wood. This method is developed for the gluing of wood, the vulcanization of rubber, and the treatment of plastics.

Sheet-Metal Conveyor System: North American 22-Station Fabrication Equipment to Eliminate Truck Transport. *Aircraft Production*, Vol. 9, No. 102, April, 1947, pp. 151, 152, illus.

Application of the Properties of Cushioning Materials in the Design of Cushions (A Study Initiated by the Container and Packaging Branch, Air Matériel Command, Wright Field). *U.S., Forest Products Laboratory, Madison, Wis., Report No. R1627*, September, 1946. 69 pp., figs.

Recovery of Metals from Scrapped Airplanes; a Review of German Practice at the End of the War. James T. Kemp, Herbert H. Hall, and A. J. Sidery. *Combined Intelligence Objectives Sub-Committee, Item No. 21, File No. 32-55*, August, 1945. 27 pp., illus. British Information Services, New York. $1.00.

Production Tools and Equipment

Profiling Impeller Vanes. II. *Aircraft Production*, Vol. 9, No. 103, May, 1947, pp. 183–188, illus. (Cf. AER 6/47:52.)

A description of the hydraulic servomechanism by which the Cincinnati hydraulic profiling machine translates the contours of a master pattern into the movement of cutters that simultaneously shape two stampings. This tool is being used by the de Havilland Engine Company, Ltd., for the machining of gas-turbine vanes. The Keller machine used by de Havilland for the same purpose is also described.

Seafire Leading-Edge Skins; Stretching, Routing and Drilling Equipment for Mark 47 Production. *Aircraft Production*, Vol. 9, No. 103, May, 1947, pp. 177–182, illus.

Plastics in German Aircraft Tooling. James T. Grey. *Combined Intelligence Objectives Sub-Committee, Item No. 5, 21, 25, 27, File No. 32-26.* 27 pp. British Information Services, New York. $0.90.

Propellers

A Transonic Propeller of Triangular Plan Form. Herbert S. Ribner. *U.S., N.A.C.A., Technical Note No. 1303*, May, 1947. 43 pp., figs. 5 references.

The critical speed of a propeller can be raised by using wide thin blade sections and by sweeping the blades forward or rearward. High bending stresses caused by centrifugal force limit the amount of sweep that can be used. An isosceles triangle twisted into a screw surface about its axis is proposed as a propeller for transonic flight speeds. The purpose is to attain the drag reduction associated with large sweepback in a structurally practicable configuration. A mathematical theory for such a propeller is presented. Calculations taking account of wave and skin-friction drag indicate a net efficiency of the order of 80 per cent at Mach Number 1.1. A 12-ft. propeller is estimated to be able to absorb 18,500 b.hp. at 840 m.p.h. at sea level.

Strip Theory Method of Calculation for Airscrews on High Speed Aeroplanes. C. N. H. Lock, R. C. Pankhurst, and J. F. C. Conn. With an **Appendix, Calculation of k (Inflow Factor Corresponding to Helicoid Angle ϕ) near the Blade Roots, by J. N. Veasey.** *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2035*, October, 1945. 54 pp., tables. 17 references. British Information Services, New York. $2.65.

A simplified eight-point strip theory method of calculating the free-air performance of a propeller up to tip Mach Numbers near the velocity of sound. The method determines values of torque grading, thrust grading, and power loss gradings; these are integrated arithmetically to give free air thrust, torque, and efficiency. The integrating coefficients are tabulated.

Air-Flow Surveys in the Region of the Tail Surfaces of a Single-Engine Airplane Equipped with Dual-Rotating Propellers. Harold H. Sweberg. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-424)*, March, 1943. 29 pp., illus. 5 references.

Effect of a Trailing-Edge Extension on the Characteristics of a Propeller Section. Theodore Theodorsen and George W. Stickle. *U.S., N.A.C.A., Advance Confidential Report No. L4I21 (Wartime Report No. L-637)*, September, 1944. 22 pp., figs. 3 references.

Contra-Rotating Airscrew Experiments for Hispano Suiza, 1939. J. Valensi. Translated by R. C. Pankhurst and J. N. Veasey. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2051*, May 26, 1945. 33 pp., figs. British Information Services, New York. $1.75.

Results and analysis of wind-tunnel experiments to determine (1) the pitch of the rear propeller for various settings of the front propeller, at maximum efficiency of the front propeller, (2) the effect of changes of gap for various settings of the front propeller, (3) the effect of changes of blade design, and (4) the effect of the reduction of the diameter of the rear propeller from 0.70 m. to approximately 0.67 m. by cropping the blades. Experiments previously conducted by Lesley and Eula were not done with the propeller mounted ahead of a body. Since this amounts to testing an isolated propeller, there are appreciable discrepancies between their results and those of this series. The curves given by Lesley are therefore not applicable in practice.

French Develop New Propellers. *Aviation News*, Vol. 7, No. 17, May 5, 1947, pp. 15, 16, illus.

Hélices Ratier has developed all-metal, variable-pitch propellers for light planes with engines of 70–125 and 140–220 hp. Pitch change is accomplished by a balancing counterweight fitted to each blade and held by the blade clamping ring. The aluminum-alloy blades have a lag angle incorporated in the rotation plane.

The Determination of Propeller Power Coefficients by Flight Tests on a Spitfire Vc Aircraft. A. R. Majcherczyk and G. S. Hislop. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2092*, January, 1944. 18 pp., figs. 3 references. British Information Services, New York. $1.05.

Critical Speeds and Profile Drag of the Inboard Sections of a Conventional Propeller. Arvo A. Luoma. *U.S., N.A.C.A., Advance Restricted Report (Wartime Report No. L-369)*, September, 1941. 23 pp., figs. 6 references.

Effects of Compressibility on Maximum Lift Coefficients for Six Propeller Airfoils. Harold E. Cleary. *U.S., Advance Confidential Report No. L4L21a (Wartime Report No. L-514)*, January, 1945. 18 pp., figs. 5 references.

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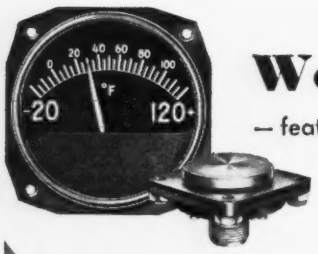

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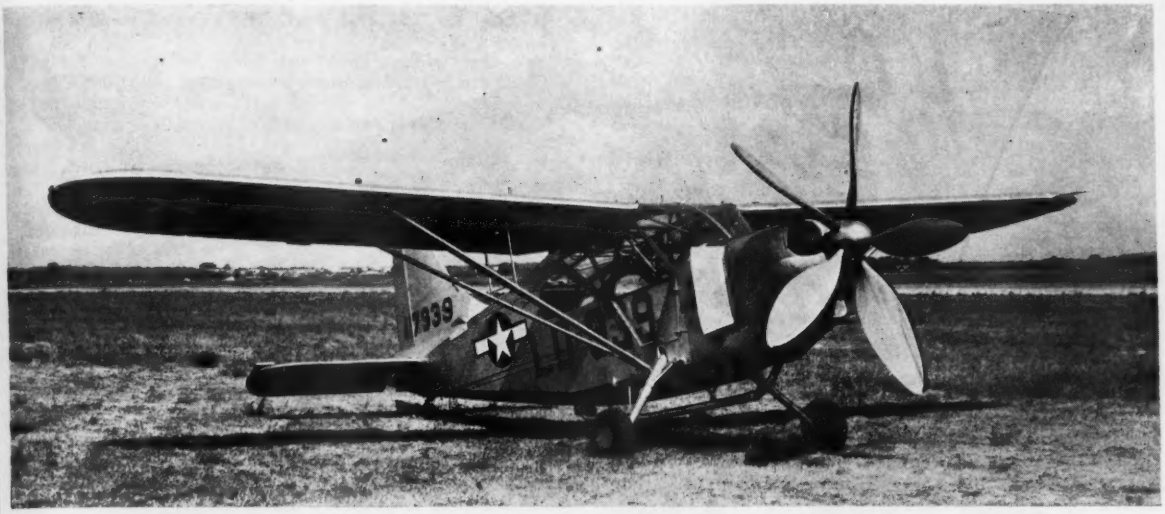


Army Stinson L-5 airplane modified by the N.A.C.A. to demonstrate the effectiveness of a five-blade propeller in reducing airplane noise. The five-blade propeller, with the engine geared-down by a ratio of 2.8 to 1, allows the full power of the engine to be absorbed at greatly reduced propeller tip speed.

Effect of Blade Loading on the Climb and High-Speed Performance of a Three-Blade Hamilton Standard No. 6507A-2 Propeller on a Republic P-47D Airplane. John J. Gardner. *U.S., N.A.C.A., Memorandum Report No. L5G09a* (*Wartime Report No. L-594*), July, 1945. 24 pp., illus. 1 reference.

An Experimental Investigation of the Thrust and Torque Produced by Propellers Used as Aerodynamic Brakes. William S. Hedrick and William M. Douglass. *U.S., N.A.C.A., Advance Restricted Report No. 4H26* (*Wartime Report No. A-27*), August, 1944. 29 pp., illus. 1 reference.

Working Charts for the Computation of Propeller Thrust Throughout the Take-Off Range. Gerald L. Desmond and Robert F. Freitag. *U.S., N.A.C.A., Advance Restricted Report No. 3G26* (*Wartime Report No. W-100*), July, 1943. 21 pp., figs. 6 references.

Comparison of Calculated and Experimental Propeller Characteristics for Four-, Six-, and Eight-Blade Single-Rotating Propellers. John L. Crigler. *U.S., N.A.C.A., Advance Confidential Report No. 4B04* (*Wartime Report No. L-362*), February, 1944. 29 pp., figs. 5 references.

The Effect of Propeller Operation on the Air Flow in the Region of the Tail Plane for a Twin-Engine Tractor Monoplane. Harold H. Sweberg. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-381*), August, 1942. 56 pp., figs. 11 references.

The Effects of Hub Drag, Solidity, Dual Rotation, and Number of Blades upon the Efficiency of High-Pitch Propellers. Elliott G. Reid. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. W-84*), October, 1941. 51 pp., illus. 11 references.

Representative Operating Charts of Propellers Tested in the NACA 20-Foot Propeller-Research Tunnel. W. H. Gray and Nicholas Mastrocola. *U.S., N.A.C.A., Advance Restricted Report No. 3I25* (*Wartime Report No. L-286*), September, 1943. 20 pp., figs.

Wind-Tunnel Tests of Eight-Blade Single- and Dual-Rotating Propellers in the Tractor Position. David Biermann and W. H. Gray. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-384*), November, 1941. 33 pp., figs. 2 references.

Wind-Tunnel Tests of a Twin-Engine Model to Determine the Effect of Direction of Propeller Rotation on the Static-Stability Characteristics. Francis M. Rogallo and Robert S. Swanson. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-295*), January, 1943. 51 pp., figs. 3 references.

Wind-Tunnel Tests of Single- and Dual-Rotating Tractor Propellers of Large Blade Width. David Biermann, W. H. Gray, and Julian D. Maynard. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-385*), September, 1942. 54 pp., illus. 5 references.

Wind-Tunnel Tests of Single- and Dual-Rotating Pusher Propellers Having from Three to Eight Blades. David Biermann and W. H. Gray. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-359*), February, 1942. 61 pp., illus. 3 references.

Wind-Tunnel Vibration Tests of Dual-Rotating Propellers. Mason F. Miller. *U.S., N.A.C.A., Advance Restricted Report No. 3I11* (*Wartime Report No. L-405*), September, 1943. 62 pp., illus. 6 references.

Eight-Blade Rotol; Details of Latest Hydraulic Contra-Rotating Airscrew, Stationary Cylinder and Sliding Piston. *Flight*, Vol. 51, No. 2000, April 24, 1947, pp. 372, 373, diagr.

The de Havilland Pre-Setting Propeller Governor. *De Havilland Gazette*, No. 37, February, 1947, p. 9, figs. (Cf. AER 4/47:65.)

Radio and Electronics

Basic Investigations on the Question of Frequency Direction Finding. H. Kaule. (*ZWB/FB/749*, January, 1939.) *U.S., Army Air Forces, Translation F-TS-914-RE*, April, 1947. 17 pp., diagrs.

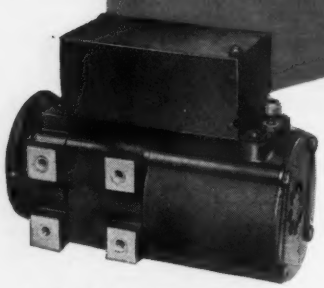
Description and principles of a German direction finder that utilizes frequency modulation caused by the Doppler effect. A wave is transmitted from the airplane to a ground station which beams back to the aircraft simultaneously the frequency received and its characteristic harmonic. The wave received by the airplane is compared with the original wave transmitted and the beats are recorded on a tape. The system operated successfully. Angular direction finding was accomplished. The disturbances from indirect radiation and from night error were found to be tolerable.

Hughes Demonstrates New Lightweight Radar Warning Device. *Aviation News*, Vol. 7, No. 17, May 5, 1947, p. 9.

Howard Hughes' radar obstacle warning system has a hemispheric forward-and-down search pattern. The system actuates either a blinker light or a horn in the cockpit, instead of the usual cathode-ray indicator. It may be set for either of two ranges, 500 ft. or 2,000 ft. The installation weighs 15 lbs.

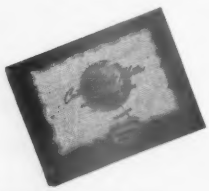
TWA, Hughes Aircraft Developing New Airline Radar Safety Devices. Robert Hotz. *Aviation News*, Vol. 7, No. 19, May 12, 1947, pp. 28, 29, illus.

Wartime radar is being adapted as a terrain-clearance indicator and as a radar identification system to provide positive identification and positive bearings. The clearance indicator will have some use as an anticollision device. An indicator for turbulence along the flight path is under development. It operates by measuring the intensity of electric charges in the atmosphere.



EEMCO D-289 water injector motor, showing mounting bosses cast integrally with frame. Castings are of heat-treated aluminum, with Rosan inserts used. Motor, 27 volt DC; output speed, 3750 RPM; 3-minute duty cycle.

Water injection in the J-33 turbo-jet engine in the P-80-B "Shooting Star" increases take-off and climb performance materially. Achievement of these advantages demanded a water injector motor with a lot of power, but in a small package. Lockheed put it up to EEMCO. The result was a 4.15 hp. *explosion-proof* motor with integral gear box, weighing only 15 pounds. A radio noise filter completes the unit. Here is a typical example of outstanding results when tough problems in custom-built motor design and development are put up to EEMCO.



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A Compact Lightweight Amplifier for Radar. P. L. Hammann. *Bell Laboratories Record*, Vol. 25, No. 4, April, 1947, pp. 146–149, illus.

The 6AK5 amplifier, which has found application in the AN/APS-4 radar for carrier-based planes and in the Bat radar-directed bomb, is described in detail.

Influence on the Ground Wave Field due to Inhomogeneous Ground Characteristics. J. Grosskopf and K. Vogt. (*Forschungsanstalt der Deutschen Reichspost, ZWB/UM/693*, September 17, 1942.) *U.S., Army Air Forces, Translation No. F-TS-1842-RE*, March, 1947. 6 pp., figs. 2 references.

Influence of the Reflected Impulse Shape upon the Range and Measurement of Range. W. T. Runge. (*ZWB/UM/Re/795*, February 1, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1846-RE*, March, 1947. 10 pp., figs.

"Knickebein" Homing Antenna Device. Runge (*Halle a. d. Saale, Luftnachrichtenschule, EIS/2/2*, February, 1944.) *U.S., Army Air Forces, Translation No. F-TS-2603-RE*, March, 1947. 26 pp., illus.

Comparative Measurements on an Umbrella Antenna and on a Bent Marconi Antenna. Harmening. (*ZWB/FB/Re/723.*) *U.S., Army Air Forces, Translation No. F-TS-1090-RE*, April, 1947. 34 pp., figs. 7 references.

Radiation Energy and Ground Absorption of Dipole Antennas. A. Sommerfeld and F. Renner. (*EIS/5/PSN/26; Annalen der Physik*, Vol. 41, No. 2, 1942.) *U.S., Army Air Forces, Translation No. F-TS-1071-RE*, April, 1947. 36 pp., figs.

Model Experiments Regarding Space Radiation Patterns of Various Antenna Forms Between Two Aircraft with Parallel Axes. Graf Soden. (*ZWB/FB/Re/273*, March, 1935.) *U.S., Army Air Forces, Translation No. F-TS-1099-RE*, April, 1947. 22 pp., illus.

Radio Equipment in the Short Solents: Comfort and Convenience in Operator's Compartment: Full Range of Aids to Navigation. Basil R. Clarke. *Flight*, Vol. 51, No. 1998, April 10, 1947, pp. 320, 321, illus.

High Power Radar Jagdhaus. A. M. Stevens. *U.S., Field Information Agency, Technical, Final Report No. 609*, December 12, 1945. 13 pp., illus. British Information Services, New York. $0.45.

Basic Magnetic Oscillation of Ellipsoidal Cavity Resonators. H. Geppert and F. Schaefke. (*ZWB/RB/Re/2004*, October, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1089-RE*, April, 1947. 28 pp., figs. 5 references.

Supersensitive Movable-Coil Type DC-Relays Without Spring Bias, for Automatic and Tele-Control and Tele-Metering. (*Berlin, Albert Patin Werkstatten für Fernsteuerungstechnik, Mx/AP/S1/4.*) *U.S., Army Air Forces, Translation No. F-TS-1066-RE*, April, 1947. 16 pp., figs.

Air-Borne Radar Search Set Rostock. (*Werneuchen, Erprobungsstelle der Luftwaffe, EIS/BER/39*, November 26, 1942.) *U.S., Army Air Forces, Translation No. F-TS-3009-RE*, April, 1947. 8 pp., illus.

Report on Status of Radar Development. (*EIS/7/CO/43.*) *U.S., Army Air Forces, Translation No. F-TS-1079-RE*, March, 1947. 9 pp.

Centimeter Wave Tests for Long Distances. O. Stützer. (*ZWB/FB/Re/1355*, December, 1940.) *U.S., Army Air Forces, Translation No. F-TS-1060-RE*, April, 1947. 16 pp., illus.

The Antennas of the "Neptun R" Installation. Maurer. (*ZWB/FB/Re/1713*, November, 1942.) *U.S., Army Air Forces, Translation No. F-TS-1092-RE*, April, 1947. 11 pp., diagrs. The Neptun R is an air-borne radar system for warning against air attack from the rear.

Basic Characteristics of Useful Industrial Laboratory Instruments. J. S. Buhler. *The Iron Age*, Vol. 159, No. 18, May 1, 1947, pp. 58–61, figs.

A chart showing 15 types of electronic testing instruments. It explains the basic principles, the circuit arrangement, the operation, and application of each instrument.

Report on New Experiments with Supraconductors. H. Kamerlingh Onnes. *U.S., Army Air Forces, Translation No. F-TS-785-RE*, April, 1947. 8 pp., figs.

Industrial Semi-Conductor Resistances. Erwin Weise. (Berlin, 1941.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/4081T*, June, 1946. 112 pp., figs.

A Summary of Experimental Results Hitherto Obtained in the Development of a Theory of Phosphors. W. Schottky. (*ZWB/FB/1972*, May 31, 1944.) *Gt. Brit., Ministry of Supply, RTP/TIB Translation No. GDC 10/1453T.* 19 pp.

The Photo-Electric Sensitivity of Lead Sulfide. Heinz Pick. (*Electroacustic Kommanditgesellschaft, Kiel, RIS/12/19*, April, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1038-RE*, March, 1947. 27 pp., figs.

On the Photoconduction of Pure Cadmium Sulfide. I. R. Frerichs. (*ZWB/FB/Re/1874*, November, 1943.) *U.S., Army Air Forces, Translation No. F-TS-1073-RE*, March, 1947. 29 pp., figs. 9 references.

Research

Quarterly Bulletin, January 1–March 31, 1947. *Canada, National Research Council, Aeronautical Laboratories, Report No. ME 1947 (1).* 27 pp., illus.

The principal report is a history of research in snow mechanics which resulted in the development of "high-cure" laminated Bakelite aircraft skis. Icing and ice-control projects include: cloud-droplet camera, light-transmission meter, wake rake to measure propeller thrust during icing, rate-of-icing recorder, icing of the German Ju 004 jet engine, hub generator for propeller deicing, alcohol to prevent icing in turbines, and 5-wire-type wing-heating pads. A radar altimeter giving a continuous record of the distance of the aircraft from the ground along the course will be tested for topographical work. Other projects are concerned with tailless gliders, wind-tunnel interference calculations, measurement of air speed, hot-wire anemometer, heated-mirror evaporation hygrometer, high-voltage spark for schlieren photography, landing-ski tests, glider-sideslip transmitters, attitude transmitters, glow-plug ignition, fuels and lubricants at low temperatures, synthetic fuels and lubricants, flutter of wing with variable spanwise torsional and flexural forms, round nose ailerons, magnetometer trailing bomb.

Engineering Research Laboratory Management. Maurice Nelles. *Mechanical Engineering*, Vol. 69, No. 5, May, 1947, pp. 383–386, 402, illus.

The author, who was formerly with the Lockheed Aircraft Corporation, describes in detail the functions, personnel requirements, the organization, and the operation of a laboratory for a large aircraft manufacturer. Emphasis is placed on time and cost accounting and the controls needed to operate efficiently.

Rotating Wing Aircraft

Stress Analysis of Rotor Blades. Gabriel Horvay. *Journal of the Aeronautical Sciences*, Vol. 14, No. 6, June, 1947, pp. 315–332, figs. 2 references.

A tabular method is presented for the determination of the spanwise and chordwise bending moments of a rotor blade. The method does not require a preliminary smoothing of the mass and inertia distributions of the blade. It is simple to use, accurate in results, and economical in time. Calculation of the principal table takes about 3 to 4 days. The method is illustrated for the 23-ft. McDonnell blade at an advance ratio of $\mu = 0.35$.

Flight Measurements of Helicopter Blade Motion with a Comparison Between Theoretical and Experimental Results. Garry C. Myers, Jr. *U.S., N.A.C.A., Technical Note No. 1266*, April, 1947. 35 pp., illus. 9 references.

Photographic observations of the behavior of a blade in flight were obtained with a conventional single-rotor helicopter in order to measure the flapping motion, in-plane motion, and blade distortion. Comparison of measured and calculated flapping motions indicated that the coning angle and the longitudinal and lateral flapping angles may be predicted within about 1° for estimations of required control displacements for trim. The predicted rates of change of the lateral and longitudinal flapping angles with tip-speed ratio and thrust coefficient were in sufficient agreement with the measured values to indicate that available blade-motion theory will prove useful in the study of helicopter static stability. The periodic in-plane motion caused by air forces was small, having an amplitude of about 1° at a tip-speed ratio of 0.25. The proportionality between the mean drag angle and the rotor-shaft torque suggested a possible design for a simple service torquemeter. Substantial downward bending of the outer quarter of the blade indicates that tip losses must be allowed for in blade bending-stress calculations.

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Effect of Blade Stalling on the Efficiency of a Helicopter Rotor as Measured in Flight. F. B. Gustafson and Alfred Gessow. *U.S., N.A.C.A., Technical Note No. 1250*, April, 1947. 8 pp., illus. 5 references.

Drag-lift ratio is close to unity until tip angle of attack is about 12°. It then rises abruptly and reaches a value of about 2 at 16°. The calculated angle of attack of the retreating tip should be a useful parameter in connection with theoretic and experimental studies of helicopter performance.

Theory of Mechanical Oscillations of Rotors with Two Hinged Blades. Arnold M. Feingold. *U.S., N.A.C.A., Advance Restricted Report No. 3I13* (*Wartime Report No. L-312*), September, 1943. 26 pp., figs. 2 references.

Flight Tests of a Helicopter in Autorotation, Including a Comparison with Theory. Alfred Gessow and Garry C. Myers, Jr. *U.S., N.A.C.A., Technical Note No. 1267*, April, 1947. 23 pp., illus. 4 references.

Agreement between theory and experiment was obtained when calculations were based on a profile-drag polar that corresponded to "rough" airfoil sections. This theory is useful in extending the available rotor data from the power-on to the power-off condition. The use of aerodynamically cleaner blades resulted in significant gains in gliding performance.

"Lifting Propeller" and "Rotor." N. de Transche. *American Helicopter*, Vol. 6, No. 5, April, 1947, p. 13.

The definitions formulated by Dr. George de Bothezat in 1938 for the various types of rotating wing aircraft are restated in order to clarify the terminology used in technical literature.

Helicopter Flight. Ronald A. Keith. *Canadian Aviation*, Vol. 20, No. 5, May, 1947, pp. 27–29, 72, illus. Description of the preoperational check, starting procedure, take-off, and performance of the Bell 47-B helicopter.

How to Fly the Bell Model 47-B. Joseph Mashman. *American Helicopter*, Vol. 6, No. 6, May, 1947, pp. 12, 13, 26–28, illus.

Flight Tests of the Sikorsky HNS-1 (Army YR-4B) Helicopter. II—Hovering and Vertical-Flight Performance with the Original and an Alternate Set of Main-Rotor Blades, Including a Comparison with Hovering Performance Theory. F. B. Gustafson and Alfred Gessow. *U.S., N.A.C.A., Memorandum Report No. L5D09a* (*Wartime Report No. L-596*), April, 1945. 26 pp., figs. 8 references.

Flight Tests of the Sikorsky HNS-1 (Army YR-4B) Helicopter. I—Experimental Data on Level-Flight Performance with Original Rotor Blades. F. B. Gustafson. *U.S., N.A.C.A., Memorandum Report No. L5C10* (*Wartime Report No. L-595*), March, 1945. 34 pp., illus. 1 reference.

Limitations in Helicopter Design. I. J. A. J. Bennett. *American Helicopter*, Vol. 6, No. 6, May, 1947, pp. 6–8, 24–26, diagrs. (Cf. AER 6/47:53.)

Teicher-Hunt Humming Bird. William E. Hunt. *American Helicopter*, Vol. 6, No. 6, May, 1947, pp. 14, 15, 28, 29, illus.

A two-place helicopter employing a two-bladed rotor, 30.5 ft. in diameter, and a 5.2-ft. antitorque tail rotor. The main lifting rotor has a direct tilting hub.

Telescope Rotor Blades Are Tested. *Aviation News*, Vol. 7, No. 17, May 5, 1947, p. 8, illus.

Beven Brothers Engineers, Chemsford, England, are sponsoring the design of Vittorio Isacco for telescoping rotor blades. These are to be used for a safety device which, in the case of distress of a conventional aircraft, could be jettisoned from the roof of the cabin, lowering the aircraft to safety. The rotor, when extended to 30 ft., can accommodate 1,000 lbs.

French Rotary Wings. Henri A. de Villermont. *American Helicopter*, Vol. 6, No. 6, May, 1947, pp. 10, 11, illus.

First Things First. *The Aeroplane*, Vol. 72, No. 1873, May 2, 1947, pp. 449–451, illus.

The Bristol Aeroplane Company has constructed a 50-ft. spinning tower to test helicopter rotor-heads and blades. The shaft of the tower gives a clearance that eliminates ground effect. The guy ropes bracing the test stand can be tuned to simulate flight conditions of oscillation and vibration.

Rotor Testing: Spinning Tower at Filton the Largest in the World. *Flight*, Vol. 51, No. 2001, May 1, 1947, p. 385, illus. (Cf. preceding abstract.)

Factors in Helicopter Economics. Raynor F. Sturgis. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 95, 96, figs.

Data on rotary wing aircraft construction and maintenance costs show the necessity of increasing pay load and simplifying design in order to place helicopters on an operational par with fixed-wing transports. A chart gives an operating cost breakdown for twelve models.

Seaplanes and Flying Boats

Comparison of Design Specifications with the Actual Static Transverse Stability of 25 Seaplanes. Arthur W. Carter. *U.S., N.A.C.A., Technical Note No. 1253*, April, 1947. 20 pp., figs. 4 references.

The maximum amount of transverse righting moment at rest which is actually provided by auxiliary floats or stub wings for 25 seaplanes is compared with the minimum righting moment required by certain design specifications. The cross wind required to submerge the tip float of seaplanes having a gross weight greater than 20,000 lbs. is in excess of 50 m.p.h.; that required for craft of less than 20,000 lbs. is in excess of 25 m.p.h. The U.S. Navy specifications provide a wing-tip float having adequate displacement to provide satisfactory transverse stability.

Appreciation and Determination of the Hydrodynamic Qualities of Seaplanes. John B. Parkinson. *U.S., N.A.C.A., Technical Note No. 1290*, May, 1947. 24 pp., figs.

A brief summary of the hydrodynamic qualities that have been used in the Langley tanks to evaluate the relative merits of various seaplanes.

High-Performance Amphibian: The Supermarine Seagull with Variable-Incidence Wing, *Griffon Engine and Contra-Rotating Airscrew. Flight*, Vol. 51, No. 2001, May 1, 1947, pp. 383, 384, illus.

Tests of a Dynamic Model in NACA Tank No. 1 to Determine the Effect of Length of Afterbody, Angle of Afterbody Keel, Gross Load, and a Pointed Step on Landing and Planing Stability. Norman S. Land and Lindsay J. Lina. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-400*), March, 1943. 28 pp., figs. 1 reference.

JRM-1 Landing Impact Characteristics from Model Tests. J. D. Pierson. *U.S., N.A.C.A., Advance Restricted Report No. 5L03* (*Wartime Report No. W-106*), February, 1946. 17 pp., illus. 3 references.

An Analysis of the Skipping Characteristics of Some Full-Size Flying Boats. F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 5J24* (*Wartime Report No. W-104*), January, 1946. 20 pp., figs. 16 references.

Aerodynamic and Hydrodynamic Tests of a Family of Models of Flying-Boat Hulls Derived from a Streamline Body: NACA Model 84 Series. John B. Parkinson, Roland E. Olson, Eugene C. Draley, and Arvo A. Luoma. *U.S., N.A.C.A., Advance Restricted Report No. 3I15* (*Wartime Report No. L-277*), September, 1943. 152 pp., illus. 10 references.

The Longitudinal Stability of Flying Boats as Determined by Tests of Models in the NACA Tank. II—Effect of Variations in Form of Hull on Longitudinal Stability. Starr Truscott and Roland E. Olson. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-468*), November, 1942. 43 pp., figs. 5 references.

The Effect of Dead Rise upon the Low-Angle Type of Porpoising. James M. Benson and Lindsay J. Lina. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-610*), October, 1942. 20 pp., figs. 7 references.

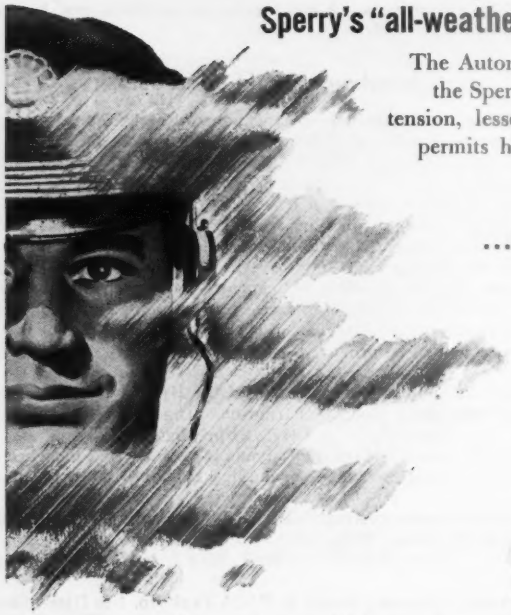
Effect of Length-Beam Ratio on Resistance and Spray of Three Models of Flying-Boat Hulls. Joe W. Bell, Charlie C. Garrison, and Howard Zeck. *U.S., N.A.C.A., Advance Restricted Report No. 3J23* (*Wartime Report No. L-358*), October, 1943. 55 pp., illus. 6 references.

Design Criterions for the Dimensions of the Forebody of a Long-Range Flying Boat. John B. Parkinson. *U.S., N.A.C.A., Advance Restricted Report No. 3K08* (*Wartime Report No. L-410*), November, 1943. 9 pp., figs. 3 references.

Stress Analysis and Structures

Numerical Methods for the Calculation of Elastic Instability. Bruno A. Boley. *Journal of the Aeronautical Sciences*, Vol. 14, No. 6, June, 1947, pp. 337–348, Discussion, pp. 348–350, figs. 24 references.

Three numerical methods for the evaluation of buckling loads requiring an operations table similar to that used in Southwell's relaxation procedure are developed and described: the Determinant Method, the Convergence Method, and the Energy Method. The Determinant made up by the elements of the



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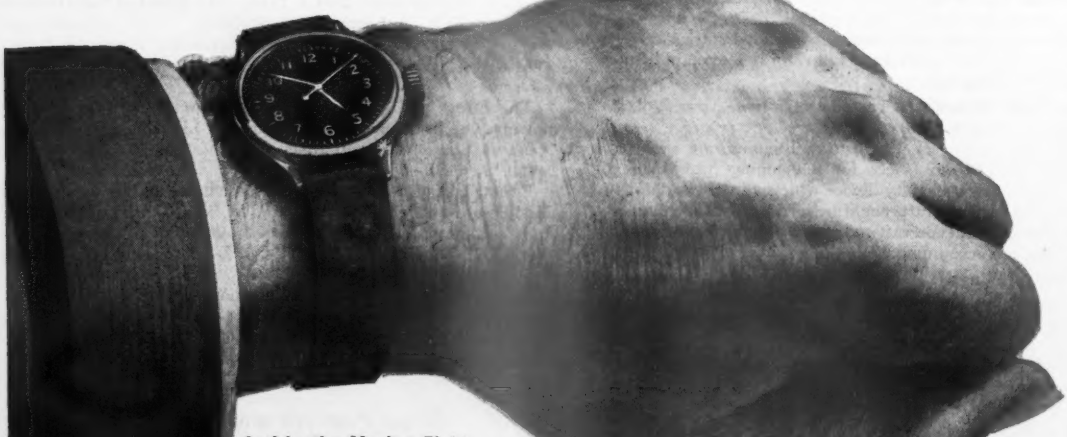

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operations table vanishes at buckling. The Convergence Method states that a systematic relaxation process based on the operations table is convergent only if the structure is stable. The principle that the second variation of the total potential is zero during buckling forms the basis of the Energy Method. The theoretic background of the three methods is discussed after a review of the setting up of operations tables and of Southwell's method in general. The procedure to be followed in each method is given and illustrated in numerical examples. Experiments on sheet and stringer combinations carried out at the Aeronautical Laboratories of the Polytechnic Institute of Brooklyn are described. Results were in good agreement with those obtained from each of the three methods of calculation.

The Associated Matrices of Bending and Coupled Bending-Torsion Vibrations. W. P. Targoff. *The Glenn L. Martin Co.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

Stress Analysis of Non Circular Rings for Monocoque Fuselages. Chi-Teh Wang and S. Ramamritham. *Daniel Guggenheim School of Aeronautics, New York University.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, July, 1947.)

Buckling of Curved Sheet in Compression and Its Relation to the Secant Modulus. E. H. Schuette. *The Dow Chemical Co.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, July, 1947.)

Free Vibration of Sweptback Wing. A. T. Zahorski. *Northrop Aircraft, Inc.* (For abstract see "I.A.S. Briefs" on page 28 of this issue, July, 1947.)

Prediction and Reduction to Minimum Properties of Plate Compressive Curves. E. H. Schuette and J. C. McDonald. *The Dow Chemical Co.* (For abstract see "I.A.S. Briefs" on page 29 of this issue, July, 1947.)

On the Nature and Conditioning of Least Work Equations in Structures. J. Morris. *Royal Aeronautical Society, Journal,* Vol. 51, No. 435, March, 1947, pp. 329–333, figs. 1 reference.

Sensitive or ill-conditioned linear simultaneous equations for the calculation of loads in a structure do not necessarily indicate sensitivity in the reactions resulting from slight variations in the applied loads. The sensitivity of the equation is affected by the choice of the unknown in the formation of the equation. Equations will be best conditioned when the self coefficients are large compared with the mutual or coupling coefficients.

The Relationship Between Fatigue and Stress Concentration. R. B. Heywood. *Aircraft Engineering,* Vol. 19, No. 217, March, 1947, pp. 81–84, illus. 15 references.

Fatigue strength is the critical factor in the design of aircraft-engine components. The theory described assumes that the fatigue strength of a notched specimen depends on the elastic stress concentration factor multiplied by another factor that depends on the absolute size of the notch. A formula is derived which gives consistent results and accounts for the size effect observed in unnotched specimens of different diameters.

An Electrical Computer for the Solution of Shear-Lag and Bolted-Joint Problems. *U.S., N.A.C.A., Technical Note No. 1281,* May, 1947. 31 pp., illus. 3 references.

The analogy between the distribution of stresses in flat stiffened panels and the distribution of electric current in a ladder-type resistance network is used as the theoretic basis of an electrical computer for rapid solution. The computer consists of variable resistors and multiple sources of current stabilized by simple electronic regulating circuits. Sufficient accuracy is obtained for the computer to be used in ordinary engineering stress analysis.

The Shear Analysis of Beams; a Statement of the Limitations of the Three Current Methods. B. A. Noble. *Aircraft Engineering,* Vol. 19, No. 217, March, 1947, p. 85, diagrs. The shear strength of beams can be best determined by assuming that the rate change of end loads between stations is constant.

Principles of Moment Distribution Applied to Stability of Structures Composed of Bars or Plates. Eugene E. Lundquist, Elbridge Z. Stowell, and Evan H. Schuette. *U.S., N.A.C.A., Advance Restricted Report No. 3K06* (*Wartime Report No. L-326*), November, 1943. 46 pp., figs. 13 references.

Critical Stresses for Plates. Eugene E. Lundquist and Evan H. Schuette. *U.S., Advance Restricted Report No. 3J27* (*Wartime Report No. L-466*), October, 1943. 33 pp., figs. 17 references.

Critical Stress for an Infinitely Long Flat Plate with Elastically Restrained Edges Under Combined Shear and Direct Stress. Elbridge Z. Stowell and Edward B. Schwartz. *U.S., N.A.C.A., Advance Restricted Report No. 3K13* (*Wartime Report No. L-340*), November, 1943. 19 pp., figs. 4 references.

An Application of Statistical Data in the Development of Gust-Load Criterions. Reginald B. Bland and T. D. Reisert. *U.S., N.A.C.A., Technical Note No. 1268,* April, 1947. 26 pp., figs. 1 reference.

The determination of the life expectancy of an airplane requires a knowledge of the frequency of occurrence of atmospheric gusts, in combination with a knowledge of the time spent at various air speeds (speed-time distribution). Speed-time distribution data have been lacking. It is possible, however, to assume reasonable or limiting values of various parameters that relate to speed, speed-time distribution, and other factors, and to apply the assumed values to representative cases. Such an analysis indicates possible extreme cases for which present design requirements are inadequate or unreasonable.

Mechanical Vibration and Aeroelasticity. P. B. Walker. *Royal Aeronautical Society, Journal,* Vol. 51, No. 436, April, 1947, pp. 417–423, figs.

The two fields should be amalgamated because of their intrinsic unity and the similarity of the techniques employed. Effective progress in either field requires the efforts of both types of specialists.

Preliminary Aerodynamic and Structural Tests Showing the Effect of Compressive Load on the Fairness of a Low-Drag Wing Specimen with Chordwise Hat-Section Stiffeners. Milton Davidson, John C. Houbolt, Norman Rafel, and Carl A. Roseman. *U.S., N.A.C.A., Advance Confidential Report No. 3L02* (*Wartime Report No. L-389*), December, 1943. 23 pp., illus. 3 references.

A Study of the Tightness and Flushness of Machine-Countersunk Rivets for Aircraft. Eugene E. Lundquist and Robert Gottlieb. *U.S., N.A.C.A., Restricted Bulletin* (*Wartime Report No. L-294*), June, 1942. 28 pp., illus.

Summary of Results of Tests Made by Aluminum Research Laboratories of Spot-Welded Joints and Structural Elements. E. C. Hartmann and G. W. Stickley. (*U.S., N.A.C.A., Technical Note No. 869,* November, 1942.) *The Welding Journal,* Vol. 26, No. 4, April, 1947, pp. 233s–251s, illus. 1 reference.

Stresses Around Rectangular Cut-Outs in Skin-Stringer Panels Under Axial Loads. Paul Kuhn and Edwin M. Moggio. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-399*), June, 1942. 29 pp., illus. 2 references.

Shear-Lag Tests of Two Box Beams with Flat Covers Loaded to Destruction. Patrick T. Chiarito. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-307*), October, 1942. 26 pp., illus. 4 references.

The Strength of Plane Web Systems in Incomplete Diagonal Tension. Paul Kuhn and Patrick T. Chiarito. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-367*), August, 1942. 56 pp., illus., 10 references.

Tests of Hydraulically Expanded Rivets. Merven W. Mandel, Harold Crate, and Evan H. Schuette. *U.S., N.A.C.A., Restricted Bulletin No. 4C27* (*Wartime Report No. L-293*), March, 1944. 17 pp., illus. 1 reference.

Comparative Tests of the Strength and Tightness of Commercial Flush Rivets of One Type and NACA Flush Rivets in Machine-Countersunk and Counterpunched Joints. Merven W. Mandel. *U.S., N.A.C.A., Restricted Bulletin No. 4B18* (*Wartime Report No. L-297*), 14 pp., figs. 4 references.

Torsion Tests of Stiffened Circular Cylinders. R. L. Moore and C. Wescoat. *U.S., N.A.C.A., Advance Restricted Report No. 4E31* (*Wartime Report No. W-89*), May, 1944. 56 pp., illus. 7 references.

Tests of Beams Having Webs with Large Circular Lightening Holes. L. Ross Levin. *U.S., N.A.C.A., Restricted Bulletin No. 4B23* (*Wartime Report No. L-524*), February, 1944. 11 pp., figs. 2 references.

The Effect of Angle of Bend Between Plate Elements on the Local Instability of Formed Z-Sections. J. Albert Roy and Evan H. Schuette. *U.S., N.A.C.A., Restricted Bulletin No. L4I26* (*Wartime Report No. L-268*), September, 1944. 15 pp., illus. 3 references.

A Procedure for the Shear-Lag Analysis of Box Beams. Paul Kuhn. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-401*), January, 1943. 13 pp., figs. 3 references.

(*Continued on page 77*)

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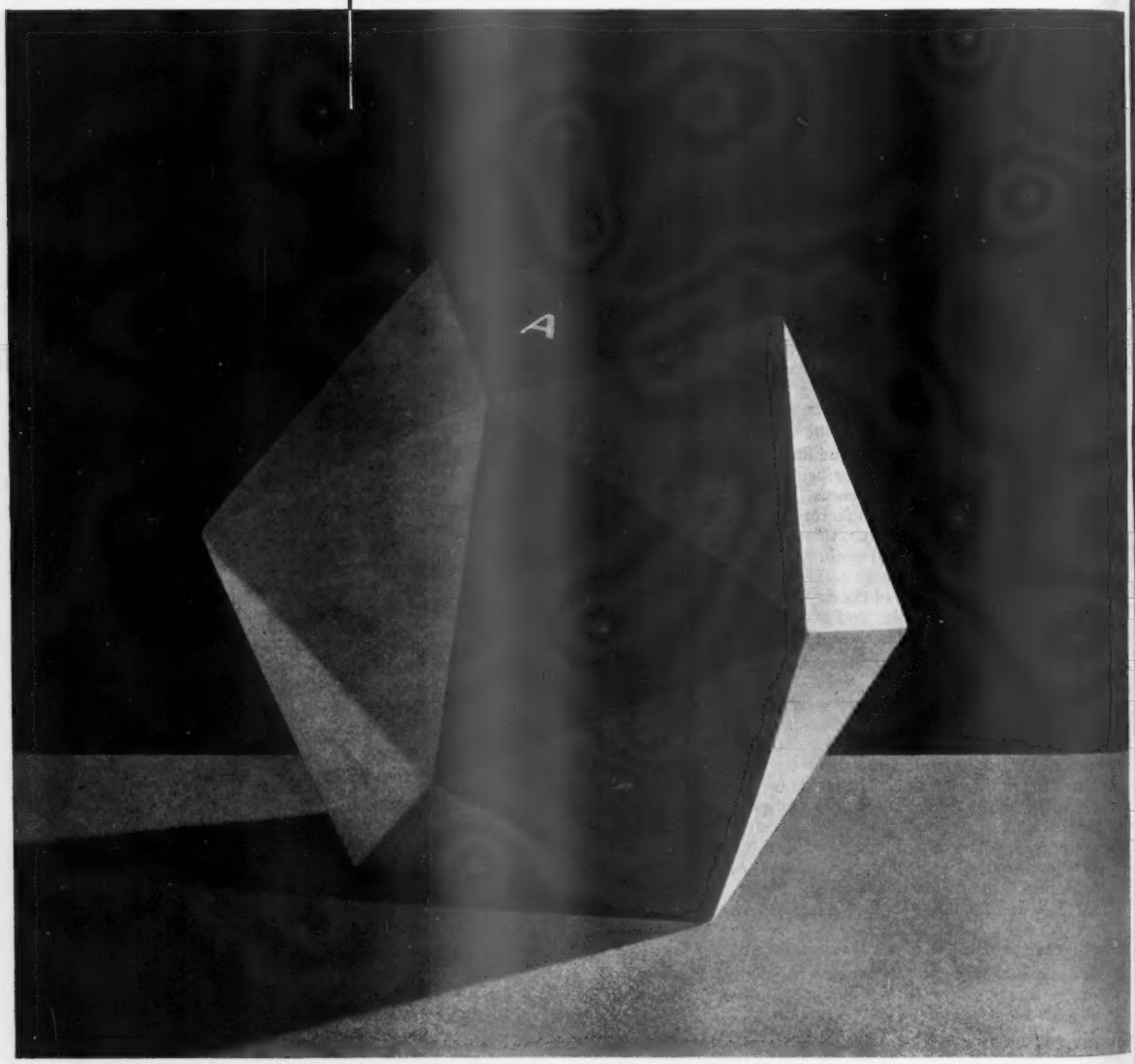

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Books

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Royal Aeronautical Society Data Sheets: Aerodynamics, 2d Issue, May 1946; Stressed Skin Structures, March, 1946. London, Royal Aeronautical Society, 1946. 2 Vols. 135 204 pp., figs. Loose-leaf.

Frequently the results of much valuable work, both technical and practical, are not applied because they are buried in a large number of technical reports that aircraft designers do not have the time to discover and read. To remedy this situation, The Royal Aeronautical Society, in 1942, appointed a committee to examine the available reports and papers on aerodynamics and stressed skin structures, to correlate and check the conclusions of the authors, and to present the best information as design curves in convenient and useful form. Assistance in this work was given by the Ministry of Supply, the Society of British Aircraft Constructors, and by consultants in industry, in official establishments, and in universities. In this way, access was gained to much unpublished British work.

The design curves for a particular topic are printed on one side of each data sheet. The other side of the sheet consists of a listing of the symbols used and their meaning, together with notes explaining the use and application of the curves. The derivation of the curves from specified formulas or other data sheets is also given; often the derivation is stated simply by citing the literature. Reference is usually made to the more accessible reports but in some cases the original sources are given. With few exceptions, each data sheet is accompanied by a worked-out example. The data sheets on aerodynamics are classified under a main heading, the aerodynamic effects, and the physical conditions of the airflow. The main headings are: aircraft, wings, bodies, controls, and flaps. The aerodynamic effects considered are: lift; drag; lateral force; hinge moment; pressure distribution; and rolling, yawing, and pitching moments. Physical conditions of the airflow include Reynolds Number, compressibility, and boundary layer.

The data sheets on stressed skin structures are classified according to the structural component to which they refer and according to the nature of the applied loads. Structural components are grouped as follows: general considerations, struts, panels, frames, fuselages, and wings. The applied loads include compression, tension, shear, shear with compression or tension, bending, torsion, bending and torsion, and pressure. The data published in these volumes were held in secret status during the war and were only recently declassified.

Helicopter Blade Analysis. A. A. Nikolsky and E. Seckel. (Princeton University, Aeronautical Engineering Laboratory, Report No. 100, January 31, 1947.) Wright Field, Dayton, Ohio, U.S. Army Air Forces, Air Matériel Command, 1947. 285 pp., figs.

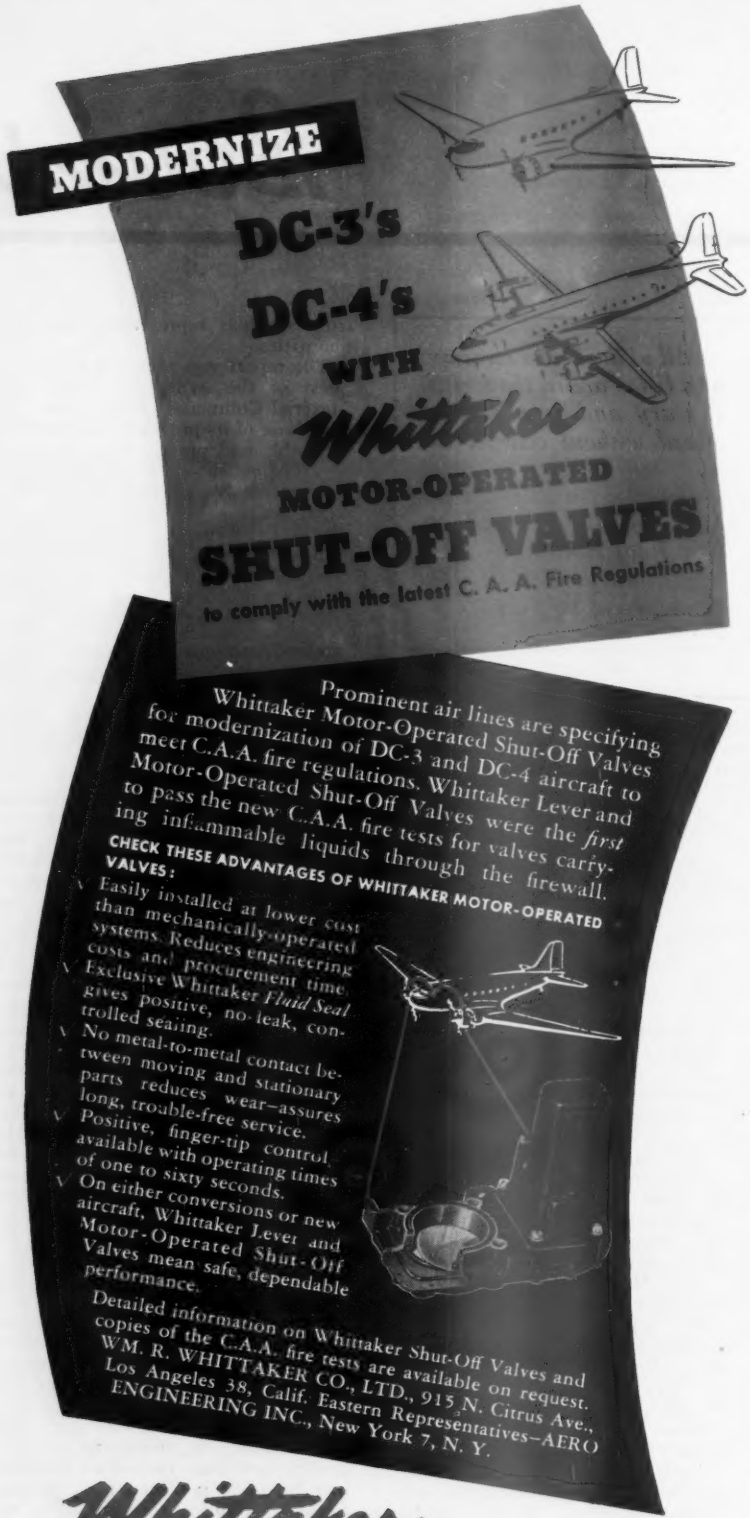
The primary purpose of this report is to give the theory and derivations necessary for the structural analysis of helicopter rotor blades in steady flight. The data can easily be made applicable to accelerated flight. Part I contains material of a general nature applicable to all types of rotors. The theory and derivations necessary for the structural analysis of articulated blades equipped with mechanical damping devices are covered in Part II. Part III discusses center-hinged blades rigid to the plane of rotation (see-saw type). The blades are assumed to have a "δ" hinge and built-in coning. In Part IV single-blade rotors are considered with five types of blade attachment. Part V is devoted to rotors with the blades rigidly attached to the hub. A brief discussion of some factors that will influence the establishment of a set of design criteria for helicopter rotor blades is presented in Part VI. A so-called "rational system" of nomenclature has been used throughout with the "classical system" given side by side where possible. The "rational system" was preferred because less memorization of symbols is required, and there should be less chance of confusion from symbols representing any two quantities.

The report was prepared at the request of the Army Air Forces Air Matériel Command, Wright Field, as one phase of its program to determine a reliable and practical set of design criteria for helicopters. The authors have attempted to make the book as self-contained as possible. They have not undertaken the actual establishment of a set of design critera but have compiled material which when applied to design problems, should aid in the establishment of such criteria.

Aérodynamique. R. Pouit. Paris, Dunod, 1947. 255 pp., diagrs. 880 fr.

The author observes that aerodynamics has today taken its place in the equipment of the engineer and his aim is to interest the generality of engineers in the subject. Although the phenomena are especially presented in their physical aspects, the mathematical notions upon which the better-known theories depend are developed in integrated fashion. For example, in the first chapter on general laws, the principle of similitude is introduced and the argument of similitude applied to wings and propellers is rationally determined. The following two chapters on potential flow include discussion of equations of Lamb, Lagrange, and Laplace, the Magnus effect, the Kutta-Joukowsky theorem, and conformal representation. Poiseuille's formula and the equations of Navier-Stokes and Prandtl are included in the chapter on movements of viscous fluids and laminar flow. Other chapters take up the mechanics of turbulent flow; resistance in the movement of bodies in fluids, and separation and wakes; lift theory, including rotating wings and propellers; and flow of compressible fluids. There are separate chapters on methods of and apparatus for measurement, and practical formulas and experimental results.

In the appendix several particular mathematical developments are discussed, including Thomson's theorem in relation to potential flow, properties of complex numbers, analytic functions of complex variables, their application to simple flows and to more complicated flows through conformal transformation, the Coanda effect, and heat transmission by forced connection. A final note deals with the theory of thermopropulsion by direct reaction.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Guide to the Literature of Mathematics and Physics, Including Related Works on Engineering Science. Nathan Grier Parke, III. New York, McGraw-Hill Book Co., Inc., 1947. 205 pp. $5.00.

A practical guide to the literature of mathematics and physics has long been needed. Nearly 40 years have passed since the publication of Müller's *Führer durch die Mathematische Literatur*. Miller's *Historical Introduction to Mathematical Literature*, published in 1916, had limitations for practical work and study. No formal guide to the written work on physics has previously been published. The physicist has had to depend on the excellent guides to chemical literature by Crane and Patterson, Soule, and Mellon. A comprehensive American guide to engineering literature remains to be written, but Mr. Parke's broad interpretation of the basic sciences and his inclusion of works on aeronautical, electrical, radio, and mechanical engineering have gone far toward supplying this need.

The principles of reading and study, literature searching, library techniques, and the nature of types of printed information are ably presented in the first part of the book and can be applied by scientists, engineers, teachers, librarians, and students in all the branches of the physical sciences and engineering. The second part is bibliographical, containing about 2,300 entries for books and articles under about 150 subject headings. Each subject heading is delineated in one or two paragraphs with suggestions of related headings and, in some cases, mention of titles that are especially useful. Completeness is not claimed for the lists, which have been carefully selected and compared with various reference collections. Books in European languages and out-of-print books are included. Additions could be profitably made, particularly in engineering subjects. The arrangement of the material for use is excellent. The table of contents includes the alphabetical list of subject headings. A classified list of these headings precedes the bibliographical part, and author and alphabetical subject indexes complete the book.

The author is a research associate in physics in the Research Laboratory of Electronics at the Massachusetts Institute of Technology. The book can be highly recommended.

Democracy's Air Arsenal. Frank J. Taylor and Lawton Wright. New York, Duell Sloan and Pearce, 1947. 208 pp., illus. $7.50.

The authors tell the story of the warplane production achievements of the seven companies comprising the Aircraft War Production Council, West Coast—Boeing, Consolidated-Vultee, Douglas, Lockheed, North American, Northrop, and Ryan. The book constitutes a pictorial study of the many phases of the aircraft in-

dustry's war effort and contains a large number of photographs of planes, aircraft components, manufacturing operations, and the results of bombing attacks.

The story is told in terms of the actual combat records of the planes that the seven Council-Member companies produced. Although the text is confined principally to a description of the production achievements of the West Coast plants, it does not neglect to pay tribute to aircraft manufacturers in other sections of the country, suppliers, subcontractors, and factory workers. An index to the persons and aircraft mentioned in the text is included.

Other Books Received

AIR TRANSPORT

Trends in Ground and Indirect Expenses in the Certified Domestic Air Transportation Industry. John B. Ford. Washington, The Author, 1947. 50 pp., tables. $10. The prospect of reduction of air passenger rates and the sound economic operation of the industry is impossible unless ground and indirect expenses are reduced. Increase of these costs despite increased load factors, and a difference in cost per passenger of as much as $16 between different air lines indicate unnecessary expenditures and wasteful operation. A detailed statistical analysis of the costs of the major air carriers for 1939–1946 points to possible remedies for this situation.

AIRPORTS

Louisiana Air Facilities, 1947. Louisiana Department of Public Works, Aeronautics Division, Baton Rouge, 1947. 210 pp., illus. Information and data on the airport and airfield facilities of towns and cities throughout Louisiana, with maps of all airfields in the vicinity of each town. Charts show radio range instrument approach procedure for six airports.

Air Harbors Data Book. College Point, N.Y., Edo Aircraft Corp., 1946. 22 pp., illus. Information about the choosing of a float base site, how to build ramps and docks, seaplane marine railways, types of seaplane dollies, base accessories, and construction economies.

BIOGRAPHY

Famous Men of Science. Sarah K. Bolton, Revised by Edward W. Sanderson. New York, Thomas Y. Crowell Co., 1946. 308 pp., illus. $2.50. The twentieth printing of a collection of popular biographies of outstanding scientists from Copernicus to Harold C. Urey.

BLUEPRINTS

The Blueprint Language of the Machine Industries. Henry Cecil Spencer and Hiram E. Grant. New York, The Macmillan Co., 1947. 255 pp., diagrs. $5.00. The authors' aim has been to provide a thoroughly practical book on blueprint reading which will adequately meet the requirements of industry. It is intended for fundamental training in the subject, and emphasis is placed on the visualization of views of objects. Working sheets are provided at the end of each chapter. The problem sheets have been used repeatedly in blueprint-reading classes conducted at the University of Wisconsin and at the Illinois Institute of Technology.

BUSINESS AND FINANCE

National Aircraft Blue Book. Volume 1, Number 1, Effective April 1, 1947. Chicago, National Market Reports, Inc., 1947. 192 pp. $7.50 per year. An informative guide prepared for those engaged in buying, selling, financing, and insuring aircraft. Included in this edition is a listing of all aircraft models up to 450 hp. which are still in existence. Essential identification data, horsepower, seating capacity, and original factory prices are given, together with average appraisal valuations. Accessories are listed separately and appraised.

ENGINES

Rolls-Royce Merlin 620 & 621, Including 600: Performance and Installation Data. (Subject to Revision.) (Publication No. T.S.D. 60, Issue Two.) Derby, England, Rolls-Royce Ltd., March, 1947. 31 pp., diagrs. Specifications, drawings of the engines and their components, performance curves, and installation requirements.

FLIGHTS

Rocketing Round the World. Milton Reynolds. New York, Greenberg Publisher, 1947. 167 pp., illus. $2.50. Bound together with a reprint of his earlier book, *Hasta La Vista*, this is an amusing travelog of a trip around the world by airplane.

JUVENILE

Balloonist from Brazil. Laura Antoinette Stevers. Chicago, Beckley-Cardy Co., 1947. 83 pp., illus. $1.00. A biography of Alberto Santos-Dumont—how he constructed a practical dirigible, made his first airplane flight, flew his airship around the Eiffel Tower, and other adventures and achievements. Intended for fifth- to eighth-grade levels.

The Skyrocket. Berta and Elmer Hader. New York, The Macmillan Co., 1946. 148 pp., illus. $2.50. The story of a boy's experiences in an imaginary jet-propelled mail plane that circled the world in 24 hours.

MATHEMATICS

Tables of Integrals and Other Mathematical Data. Herbert Bristol Dwight. Revised Edition. New York, The Macmillan Co., 1947. 250 pp. $2.50. Additional material on inverse functions of complex quantities and on Bessel functions, and a probability integral table have been added to this edition.

Advanced Calculus. David V. Widder. New York, Prentice-Hall, Inc., 1947. 432 pp. College Edition, $4.50. Although primarily designed for students who have had three or four semesters of elementary calculus, this book is so arranged that it may be used by those with somewhat less preparation. Unlike the traditional course in advanced calculus, three of the chapters are devoted to the Stieltjes integral and the Laplace transform because of the increased importance of these two subjects to the student of pure or applied mathematics.

MEDICINE

Annual Meeting of Committee on Selection and Training of Aircraft Pilots, June 28, 1946. Civil Aeronautics Administration and National Research Council. Washington, National Academy of Sciences, 1946. 68 pp., figs. The papers presented were on the following subjects: the effectiveness of directed attention to instruments as a training aid; the agreement between inspector's ratings as recorded on the Ohio State Flight Inventory and instrument readings obtained from photographic records; the effect of training in slow flight on landing performance; the current status of visual study; a study of visual and cardiovascular standards in relation to success in flight training (R.A.F. repeat study); research at the Psychology Branch of the Aero Medical Laboratory; aviation psychology in the United States Navy; and suggestions for further research in civilian aviation. In each case the text of the paper is given, accompanied by a verbatim account of the discussion that followed.

METALS AND ALLOYS

The Light Metals Industry. Josephine Perry. New York, Longmans, Green and Co., 1947. 128 pp., illus. $2.00. A review of the history of aluminum and magnesium, and a nontechnical description of how these metals are obtained and processed. A book for young readers.

METEOROLOGY

Teach Yourself Meteorology. Philadelphia, David McKay Co., 1947. 138 pp., illus. $1.00. A nontechnical explanation of the behavior of the atmosphere and the principles of weather forecasting. A reprint of an earlier London edition.

MILITARY AVIATION

The Revolution in Warfare. B. H. Liddell Hart. New Haven, Conn., Yale University Press, 1947. 125 pp. $2.00. As Europe became civilized the character of warfare changed until it was limited solely to an engagement between two armies. The development of automatic weapons and the airplane, combined with the modern concept of total war and unconditional surrender, has once again brought about mass slaughter and economic warfare. The author makes a plea for a realistic attitude toward the abolition of war and the establishment of conventions and rules to mitigate the ruthlessness until such time as war can be effectively outlawed. The book contains an index of names and an index of subjects.

There Will Be No Time: The Revolution in Strategy. William Liscum Borden. New York, The Macmillan Co., 1946. 225 pp. $2.50. The main thesis is that both cities and industry are obsolete as wartime weapons. Their mission must be accomplished before the fighting begins, or not at all. Victory will depend, not on the destruction of civilians, but on quick elimination of the opponent's forces and stock piles in being. The atomic bomb's tactical potentialities overshadow its possible use against bystanders. Our aircraft as a weapon became obsolescent with the firing of the first V-2 and must give way in the near future to high-speed robot missiles.

I Hold My Aim. C. H. Keith. London, George Allen and Unwin, Ltd., 1946. 174 pp., illus. 10*s*. 6*d*. The author, who held senior appointments in the R.A.F. dealing with training, design, development, and the technical policy of armament, tells of his experiences between the first and second World Wars. In addition to tracing the development of automatic weapons and bombs, he explains at length for the general reader the construction, uses, and operation of these weapons. A glossary of British aeronautical and ordnance terms is appended.

MODELS

Airplane Model Building. Gene Johnson. New York, Cornell Maritime Press, 1946. 141 pp., diagrs. $3.00. This is a clear and simple guide for the novice. It is profusely illustrated and the most elemental tools and operations are carefully described. Beginning with a simple glider model, the text concludes with a full-scale model airplane. Basic aerodynamic principles are explained in the course of the text.

NAVAL AVIATION

Brassey's Naval Annual, 1946. Edited by H. G. Thursfield. New York, The Macmillan Co., 1946. 378 pp., illus. $6.00. The 57th edition is largely devoted to the concluding sea phases of the late war. Tables of dimensions of warships of the world, including aircraft carriers, and of naval aircraft in use at the end of the war are presented in a special section.

Silicone News

DC

Through use of Silastic, Pratt & Whitney Aircraft engineers save weight and improve performance of new intercylinder assembly designed to drain hot oil from rocker boxes of 3500 h.p. Wasp Major aircraft engine.

SILASTIC* *solves another aircraft problem*

Silastic *stays elastic* in arctic cold or oven heat. Unlike any other rubber-like material, Silastic is built on an inorganic framework and has unique properties which enable design engineers to solve many a troublesome problem.

Pratt & Whitney Aircraft engineers, for example, had to design an intercylinder assembly to drain hot oil from the 30 rocker boxes on the underside of the 28-cylinder Wasp Major. Metal tubing, of course, but between the tubing and the rocker boxes an elastic connector—serviceable at temperatures up to 300°F. in contact with hot oil—was necessary to absorb the relative motion between engine cylinders.

That problem of elasticity at high temperatures has plagued design engineers for generations. Pratt & Whitney Aircraft engineers, however, knew about heat-stable, oil-resistant Silastic. They had used gaskets of Silastic to seal the 56 rocker boxes of the Wasp Major.

So they designed connectors of Silastic with metal couplers to attach the tubing to the rocker boxes. A great deal of weight was saved; heat was more easily dissipated through the all-metal exterior of the assembly; and performance standards were improved.

The Silastic connectors for this job were molded of Silastic 181 by the Connecticut Hard Rubber Company of New Haven. Other Silastic stocks, serviceable over a temperature range of —70° to 350°F. continuously—up to 500°F. in intermittent use—are described in leaflet No. S 21-1.

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ORGANIZATIONS

The 99 Club, An International Organization of Licensed Women Pilots, 1929–1941. Washington, The 99 Club, 1946. 32 pp. A list of charter members and a brief history of the organization.

PETROLEUM

Petroleum Production. Vol. III. Park J. Jones. New York, Reinhold Publishing Corp., 1947. 271 pp., figs. $5.00. Part I of this volume is devoted to foundations, and contains chapters on oil ahead of water, oil production by expansion, well production capacity, the injection of water, the optima for reservoirs, and migration of oil. In Part II applications are discussed in chapters dealing with radial reservoirs, two pay intervals, impermeable wedges, saturated oil, linear reservoirs, elongated reservoirs, and bottom water.

PHOTOGRAMMETRY

Sample Computations for Spatial Resection and Space Orientation. A. O. Quinn. (Bulletin on Aerial Photogrammetry No. 17.) Syracuse, N.Y., Syracuse University, April, 1947. 27 pp. An analysis of the formulas used in the direction cosine method for the rapid solution of the spatial resection problem reveals a cyclical arrangement of the quantities involved. The use of a computation form is suggested, by which any person familiar with the calculating machine may readily determine the elements of the exterior orientation of an aerial photograph.

PLASTICS

The Chemistry and Technology of Plastics Raymond Nauth. New York, Reinhold Publishing Corp., 1947. 522 pp., illus. $9.50. A comprehensive text on thermosetting resins, thermoplastics resins, and vulcelastics; their properties, manufacture, and uses. In addition to technical data on the adaptation of these materials to industrial use, the organic chemistry of the materials is thoroughly treated. The book is divided into sections dealing with thermosetting resins, thermoplastic resins, cellulose plastics, synthetic resins, natural rubber and plywood, and mold design and equipment. A glossary of the common chemical and technical terms used in the plastics industry is included. There are numerous references to the literature and to U.S. Patents.

An Introduction to Engineering Plastics. D. Warburton Brown and Wilbur T. Harris. New York, Murray Hill Books, Inc., 1947. 274 pp., illus., $4.00. A comprehensive but simplified presentation for the industrial specialist. After plastics and their uses have been discussed in general, the manufacture and the basic materials of the principal types of plastics, their physical properties, industrial application, fabrication, and processing are covered in detail. Appendixes give lists of materials, applications, trade names, manufacturers, and recommended tolerances for phenolic and urea moldings.

Low-Pressure Laminating of Plastics. J. S. Hicks and R. J. Francis. New York, Reinhold Publishing Corp., 1947. 162 pp., illus. $4.50. An introduction to this new development in the plastics field. The scope of the book is restricted to those thermosetting resins that may be used in the curing cycle at pressures up to 100 lbs. per sq.in. Particular attention is paid to the 0 to 15 lbs. per sq.in. range. The several steps necessary to make and form the laminate are outlined. Specific note is made of the firms that can supply the materials needed. The volume is intended to be a practical handbook and does not discuss the chemistry or physics of the processes.

RELATIVITY

Relativity, The Special and General Theory. Albert Einstein. Translated by Robert W. Lawson. New York, Peter Smith, 1931. 169 pp. $2.50. A reprint of a book published in 1920, written to give an insight into the theory of relativity to those who are not conversant with the mathematics of theoretical physics.

WELDING

The Welding Encyclopedia. L. B. Mackenzie. Revised and Re-Edited by T. B. Jefferson. 12th Edition. New York, Welding Engineer Publishing Co. (Division of McGraw-Hill Publishing Co., Inc.), 1947. 1,024 pp., illus. $6.00. Revised to accommodate recent advances in welding practice. Includes a dictionary of trade names, a welding industry buyers' manual, and 16 appendixes which include conversion tables and tables of specifications and standards.

WORLD WAR II

Diagrammatic Representation of Certain Phases of the War. Gt. Brit., Offices of the Cabinet Chief of Staff Committee. London, H.M. Stationery Office, January, 1946 39 pp. 20*s*. Charts and figures brought up to the end of the war in Europe give a wide variety of statistics concerning British military, naval, and air strength, aircraft production, bombing results, flying bombs, rockets, casualties, exports and imports, and numerous other facts regarding the British Empire during the war.

The Crusaders; A History of the 42nd Bombardment Group (M), Baton Rouge, La., Army and Navy Publishing Co., 1946. 204 pp., illus. $7.00. The story of the 42nd Bombardment Group, Medium, U.S. Army Air Forces, from its activation in 1941 until the end of the war. Besides personal data on the members of the unit, the account contains a résumé of operations in the Pacific Theater.

Sky Diggers; A Tribute to the R.A.A.F. Stanley Brogden. Melbourne, Whitcombe & Tombs Pty. Ltd., 1944. 144 pp., illus. 3*s*. 6*d*. An account of the careers of some prominent pilots of the Royal Australian Air Force.

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Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Structural Designers—Engineers experienced in design of sheet-metal structures desired for large cargo aircraft project. Graduate engineers preferred. All replies held confidential. Write, Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

Layout Draftsmen—Six or more years' experience in aircraft layout and design. Cargo aircraft experience desired. Graduate engineers preferred. All replies held confidential. Write, Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

Stress Analysts—Personnel with experience on sheet metal, monocoque, cargo-type aircraft desired. Graduate engineers with 5 or more years' experience preferred. All replies held confidential. Write, Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

Chief Aerodynamicist—Services of highly qualified person to act as chief aerodynamicist. All applicants must be graduate engineers of recognized universities. Experience on cargo or large type of aircraft desirable. Applicants should write, giving complete details of education and experience, list references and salary expected, as well as availability All replies held confidential. Write, Project Engineer, Chase Aircraft Company Inc., West Trenton, N.J.

Aerodynamicists—Several positions open to qualified personnel for performance and load calculations on cargo-type aircraft. Graduate engineers preferred with at least 5 years' experience. All replies held confidential. Write, Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

Engineers—Attention newly graduated engineers: Opportunities for wide-awake hustlers who want to learn. Write, giving full particulars of scholastic record and any experience, to Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

Assistant Professor—Assistant Professor of Aeronautical Engineering wanted to teach junior and senior courses at Oregon State College. A man with graduate degree, teaching and industrial experience preferred. Address replies to B. F. Ruffner, Oregon State College, Corvallis, Ore.

Educators and Specialists—Pacific Northwest opportunity for aeronautical educators and engineering specialists. Advanced degree required, plus enthusiasm for graduate teaching and research. Excellent laboratory facilities available. Address inquiry to Aeronautical Engineering Department, University of Washington, Seattle 5, Wash.

Aerodynamicist—Person familiar with calibration of and testing procedures in high-speed wind tunnels to direct these activities on a new tunnel. Reply should contain information concerning education, experience, and when available and should be addressed to the Employment Office at Cornell Aeronautical Laboratory, 4455 Genesee Street, Box 235, Buffalo 21, N.Y.

Controls Engineer—Experienced, for development of controls and valves associated with large rocket propulsion systems in guided missiles program. Desired background: electrical or mechanical engineering degree and minimum of 5 years' experience in the practical development of valves, servomechanisms, and automatic controls. Address reply to Engineering Personnel Office, North American Aviation, Inc., Municipal Airport, Los Angeles 45, Calif.

Research Engineers and Physicists—Engineers, physicists, chemists, and mathematicians with research experience in problems related to aeronautics are needed by the National Advisory Committee for Aeronautics. Salaries for various positions requiring research experience range from $3,397 to $9,975 per year, depending on the type and level of work. Entrance positions for college graduates pay $2,644 per year. Areas of research include the following: aerodynamics, hydrodynamics, structures, materials, thermodynamics, compression and turbines, fuels and combustion, lubrication, mathematics, optics, electronics, radar, telemetering, servomechanisms, and other fields. Applications for positions or requests for further information should be addressed to the personnel officer at one of the following laboratories: Langley Memorial Aeronautical Laboratory, Hampton, Va.; Ames Aeronautical Laboratory, Moffett Field, Calif.; Aircraft Engine Research Laboratory, Cleveland.

Aircraft Equipment and Accessory Engineer—Excellent opportunity for graduate A.E., M.E. or E.E. with at least 4 year's practical experience as application engineer on electromechanical actuators, electric motors, and automatic control for aircraft. Reply to Lear, Incorporated, 110 Ionia Ave., N.W., Grand Rapids 2, Mich.

Electronic Engineer-Pilot—A position is open for a highly qualified electronic engineer who is also an expert multiengined pilot. The work will consist primarily of flight research and test of aeronautical automatic controls of many descriptions. The engineer will be involved from the inception of an idea or device, through its development stages, in the planning and flying of the tests, to the final demonstration and sales stages. It is desirable that the applicant be skilled in instrument and airways procedures or is a former air-line, N.A.T.S., or A.T.C. pilot. Apply by letter, giving engineering and flight experience and starting salary expected, to Chief Flight Test Engineer, Minneapolis-Honeywell Regulator Company, 2753 Fourth Ave. S., Minneapolis.

Engineers—Young engineering graduates with up to 3 years' experience required for test activity and aerodynamic or thermodynamic analysis on extensive and continuing development programs on nonrotating aircraft power plants. Mechanical or aeronautical engineers preferred. Address reply to Continental Aviation and Engineering Corporation, Detroit 14.

Aerodynamicists—College graduates with sound theoretical training and at least 1 year of graduate study in compressible subsonic flow and supersonic flow to do research and test work in the Supersonic Wind Tunnel of the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. This is one of the few operating supersonic wind tunnels in the country having a test section larger than 1 sq.ft. Remuneration in accordance with qualifications. Write, giving education and experience, to The Commanding General, Aberdeen Proving Ground, Md., Attention: Director, Ballistic Research Laboratories.

The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

Structural Designers—Experienced in sheet-metal aircraft structures for new helicopter design. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Layout Draftsmen—Five or more years' experience on aircraft layout and design. Rotary wing preferred. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Aerodynamicist and Vibration Specialist—Experienced in rotary wing field. Graduate engineers from recognized universities preferred. Plant located in suburb of West Philadelphia. All replies will be held confidential. Write Personnel Department, Piasecki Helicopter Corporation, Sharon Hill, Pa.

Assistant Designer—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must be capable of taking full responsibility for undercarriage design projects, and should have had some experience in design of hydraulic pumps, systems, and electro-hydraulic units. Knowledge of stress analysis and familiarity with both British and American engineering practices also desirable. This is a permanent position with good prospects. Starting salary $275 to $300 per month, depending on qualifications. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

Senior Draftsman—Wanted immediately by Canadian branch of leading aircraft hydraulics and landing-gear specialists. Must have minimum of 3 years' experience in the more mechanical side of aircraft design work and, preferably, 1 year's design experience on undercarriage and hydraulics, variable-pitch propellers, fuel systems, or other similar accessories. Should be capable of detailing any undercarriage or hydraulic layout and of carrying out elementary stress analysis. Familiarity with both British and American engineering practices also desirable. This is a permanent position with attractive prospects. Starting salary proportional to qualifications offered. Apply in writing to Chief Engineer, Dowty Equipment (Canada) Limited, 999 Aqueduct St., Montreal 3, Canada.

742. Automatic Pilot Project Engineer—Wanted by leading manufacturer of electromechanical equipment with a complete automatic pilot staff, including top-notch gyro engineers, servo engineers, and electronic engineers. Requires experienced automatic pilot engineer to take charge of automatic pilot engineering to relieve company chief executive who has handled this personally heretofore but requires a project engineer because of increased work and expanding program. Individuals in our employ know of this opening so applicant need not be concerned about writing to his own employer. Location Middle West.

741. Metallurgist—College graduate with several years' experience in aircraft industry on control of materials, processes, and process inspection. To assume charge of quality control. An expanding aircraft concern, with excellent future. All replies will be held confidential. East Coast company.

739. Instructor or Assistant Professor—To teach courses in aircraft structures or aerodynamics in Aeronautical Engineering Department in Midwestern university. Minimum of 5 years' practical experience required; master's degree and previous teaching experience desirable. In replying please give complete record of personal qualifications and experience.

730. Aeronautical Engineer—Civil Service position open in Washington, D.C., for aeronautical engineer with experience in stability and control analysis. Salary $4,902 per annum. In applying please give brief sketch of personal qualifications, education, and experience.

724. University Airport Operations Director—Director of Operations position available at airport owned and operated by a large mid-western university. The director should be a pilot and a graduate engineer, have had some experience in operating an airport, and have an interest in flight research and flight training.

718. Aerodynamicists—Services of several highly qualified aerodynamicists are required by a Midwest firm investigating supersonic wind tunnels for Government facilities. Preference given to those with experience in design of compressors, nozzles, refrigeration and drying equipment, and wind-tunnel instrumentation. A good background in supersonics, mathematics, and physics is preferred but will consider others with subsonic experience in above fields. Applicants should write giving complete details of education, experience, and salary expected.

706. Assistant Professor—To teach courses in aircraft structures and aircraft structures laboratory at an Eastern university. The primary duties of the position will be concerned with aircraft structures, but the applicant should possess enough knowledge of aerodynamics to permit him to assist occasionally in elementary aerodynamic courses. Prefer a man with teaching and practical experience. In applying, please give brief sketch of personal qualifications, education, and experience.

679. Professor of Aeronautical Engineering—To take charge of work in established department of aeronautical engineering at a large engineering college. A man with graduate degree, teaching and industrial experience preferred. Rank and salary dependent upon educational background and experience.

671. Instructor or Assistant Professor—Sought by Aeronautical Engineering Department of Southwestern university. Should have master's degree and be able to teach in fields of aerodynamics and fluid mechanics, structures, and power plants and be capable of specializing in one of these.

670. Research and Aerodynamics Engineers—Long-term helicopter development program for Army Air Forces requires additional experienced and capable engineers. Exceptional working conditions and opportunities. Work involves aerodynamics, vibration, and flutter analyses on advanced designs. Substantial experience in aerodynamics or vibration work essential. East Coast company.

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754. Aeronautical Engineer—B.S. in Aeronautical Engineering, age 26. Forty months' experience in the Army Air Corps as an engineering officer in charge of maintenance and equipment development. Desires position in aerodynamic research but will also consider other positions. Sound theoretical background in stress analysis and aerodynamics as well as practical experience in heavy aircraft maintenance. Details and references upon request.

753. Engineer—B.M.E., 1943. Nine months as assistant project engineer on automatic aircraft control. Two years as aerodynamics engineer on piloted and pilotless aircraft. For past 6 months in charge of projects to simulate in laboratory the behavior of guided missiles and their control equipment while in flight. Desires improved opportunities.

752. Engineer—Age 36, 3 years' college engineering; 2½ years as an engineer in the aircraft industry; specialist in weights and balance; holds valid A. & E. license; approximately 10 years all-round technician on all types of aircraft. Would like to represent aircraft manufacturer in the field.

751. Aeronautical Engineer—Seven years' air-line and manufacturing experience, mostly on heavy multiengined aircraft covering tool design, group leader equipment installation design, service and liaison engineering, flight testing, direction of preparation of flight and maintenance handbooks, and progressive maintenance systems for U.S. Navy and a major air line. Desires responsible position with air line or manufacturer, domestic or foreign. Excellent references furnished.

750. Aeronautical Engineer—B.Ae.E., age 24, single. Two years' experience in flight testing, primarily jet-propelled aircraft. Three and one-half years with A.A.F. as navigator, experimental engineering officer, and administrative officer. Seeks position in aeronautics, preferably development and/or liaison.

749. Administrative or Executive Engineer—Graduate Engineer, age 35, with over 12 years of aircraft experience with one company desires a responsible engineering or management position with an aircraft manufacturer or allied industry. Background includes contractual administrative work as well as broad engineering, administrative, and supervisory experience in stress analysis, and preliminary and detail production design work on naval aircraft. Will consider a position in production or sales work.

748. Aeronautical Engineer—Bachelor's and Master's degrees in Aeronautical Engineering. Presently holding responsible executive position with well-known helicopter manufacturer. Desires new connection either in industry or at recognized university. Broad general aircraft experience; author of several published papers on rotating wing aircraft and general design; well-known in industry and C.A.A. circles; teaching experience in field of structural design.

747. Helicopter Flight Test Engineer—Age 27, married. B.S.E. (Aero.), 1943. Familiar with C.A.A. flight test procedures and data reduction necessary for helicopter certifications. Four years' aviation experience includes flight-test instrumentation, conventional aircraft flight scheduling. Desires position in Midwest in related or nonrelated field where background would be of some benefit.

746. Aerodynamicist—Age 28; B.S. and M.S. degrees in Ae.E. Five years' experience in aerodynamic design of commercial and military aircraft. Considerable experience with static and dynamic stability analyses of aircraft. Desires responsible position either with aeronautical college or with aircraft industry.

745. Aeronautical Engineer-Teacher—Presently employed design engineer would prefer a change to teaching position. Work in aircraft industry or in aero-insurance field also desirable. Scholastic record includes B.S. degree in Mechanical Engineering and graduate study in applied mechanics, plus M.S. degree from Harvard Graduate School of Engineering. Over 6 years' industrial experience on gliders, large (four-engined), and small aircraft, amphibians and jets. Has been chief of structures and aerodynamics on light aircraft; handled approval of important aircraft designs while working for C.A.A.; has also handled safety and accident analysis, and C.A.A. design and liaison work for large aircraft manufacturer. Teaching experience includes graduate assistantship at leading university and appointment as Instructor in Aeronautical Engineering on part-time basis.

744. Project Engineer—Age 29; M.Ae.E. Nine years' experience in design and development of aeronautical and mechanical components. Recent experience in guided missiles and in direction of groups engaged in aeronautical development work. Especially interested in coordination of new development work.

743. Aeronautical Engineer—Bachelor of Ae.E., Master of Ae.E. from New York University, majoring in aircraft structures. One and one-half years' experience as student and graduate assistant and some experience in research department of large Eastern aircraft company. Interested in obtaining position in structural research or structural test.

740. Aeronautical Engineer—B.S. in Aeronautical Engineering. Nineteen years' experience in military and commercial development and flight testing. Specialized in aerodynamics, flight test, power plants, and weights. Has professional license. Desires position in development of personal airplane. Interested in Southern California location.

738. Aviation Representative—Executive. Married. Seven years' air-line experience. Possesses good working knowledge of all departments. Broad communications experience—supervisory and administrative. Some flying experience plus working knowledge of dispatching, meteorology, instrument flying, and navigation. Alert, reliable, mechanically inclined. Executive ability. Interested in organizing a helicopter operation, or cargo or feeder air-line. Will consider responsible position with an organization needing a well-informed aviation representative. Will furnish references on request. Interview desired.

737. Engineer—Age 33, married. Aeronautical and mechanical engineering education. Nine years' experience in aircraft industry including all phases of design and analysis of airplane structures. Would like position with growing concern. East Coast preferred.

736. Spare Parts Requirements Specialist—Graduate of 2-year aeronautical engineering technical college; C.A.A. mechanic's license; 3 years with A.T.C. and A.T.S.C. as assistant aircraft maintenance officer specializing in scheduling the repair of spare parts and anticipating need for same before actually needed. Presently employed and has 2 years' experience with a major air line, mainly in provisioning spare parts. Has a thorough practical knowledge of engineering and maintenance problems and practices. Desires connection with an air line or company planning to enter the air transportation business. Preference is New York Area.

735. Engineer—B. of A.E., 1942, with honors. Postgraduate study in mathematics. Training background includes extensive experience as a machinist and as a draftsman. Flying experience. Experience as development engineer working on all phases of aircraft propeller theory, testing, and production. Two years as an engineering officer in the U.S. Navy. Last duty as an administrative engineer with the Office of Research and Inventions. Experience with large aircraft company as a research aerodynamicist working on subsonic and supersonic rocket aircraft. Design engineer, procurement engineer, and sales engineer with mechanical machine company. Exceptional administrative and sales ability. Personable appearance and can deal effectively with people. High engineering aptitude and understanding proved many times in practice.

734. Aircraft Equipment Engineer—Age 33, married. Fourteen years' experience, including: 1½ years as aircraft mechanic; 2⅓ years as assistant chief engineer small aircraft plant; 1½ years as group leadman on experimental aircraft project, doing layout, lofting, stress analysis, weight and balance; 8 years with major aircraft company as layout draftsman, engineering designer, shop liaison engineer, modification and salvage engineer. Research and development work on passenger comfort and lightweight seating. Familiar with Army and C.A.A. regulations. Desires chance for advancement with manufacturer, research organization, or maintenance base. Prefers West Coast.

733. Engineer—Nine years' experience in manufacturing and materials and process engineering. Also some experience in stress analysis, structural testing, and design. Desires position in materials and processes, research, production design, or manufacturing field with air-line, airframe, or accessory manufacturer.

732. Chief Power-Plant Engineer—B.S. in M.E. Twenty years' experience in airplane design as draftsman, weight computer, stress analyst, flight test observer, project engineer, power-plant engineer, and chief power-plant engineer. Fifteen years as power-plant installation specialist. In charge of power-plant design and technical calculations for many outstanding military and commercial airplanes. Turbojet and rocket experience. Successful administrative record in handling design groups. Desires administrative position with progressive firm in engineering department of aircraft company or in installation department of engine manufacturer.

731. Aerodynamics; Design; Structures; Management—Experienced in all phases of aircraft design and manufacturing. Ex-assistant chief engineer, chief aerodynamicist, chief of stress, project engineer. University of Michigan graduate, B.S. Ae.E., B.S.M.E. Age 30, married. Desires work in New York City vicinity. Complete information given on request.

729. Plastics Engineer—B.S. in M.E., Cornell, 1940. Age 30, married. Wishes to organize low-pressure molding department or section of laboratory for aircraft concern designing surfaces that must carry radar equipment or have supersonic smoothness. Five years' experience in aircraft applications of plastic resins, thoroughly familiar with practical laboratory and production techniques; also with design and lofting requirements for low-pressure molds.

728. Aeronautical Engineer or Teacher—B.S. Ae.E., now completing master's work at the University of Michigan in aerodynamics, propulsion and research techniques. Received Rotary Wing Scholarship in 1946. Reads and speaks French and German. Has done tutoring in physics and aeronautics. Three years' experience as assistant project engineer on development, design, and manufacture planning for aircraft instruments and subsonic wind tunnel. Two years' experience in A.A.F., personally responsible to Chief of Maintenance, for 3rd echelon maintenance on all C-47, C-53, and P-38 aircraft in the Ninth Air Force. Desires engineering position in supersonic research, rotary wing field, or as teacher in aerodynamics, propulsion, structures, or rotary wing subjects.

727. Tool-Production Engineer—Age 34. Fifteen years' experience sheet metal and precision metalworking fields in production supervision, tool design, aircraft layout drafting, production engineering. Last 8 years in aircraft, last 2 years as Chief Tool Engineer. Capable administrator, considerable experience in labor relations. Desires position in tool or production engineering leading to responsible position requiring administrative ability.

726. Aeronautical Engineer—B.S. in Ae.E., 942, plus additional engineering studies. Age 25, single. Five years' experience, including 3 years' layout design and 2 years' engineering experience in another field having to do with the fabrication and production design of ceramic product. Experience in processing, testing, research, and field service in capacity of Practical Engineer. Prefers position in administrative capacity, field service or design group. Free to travel anywhere. Complete information will be given on request.

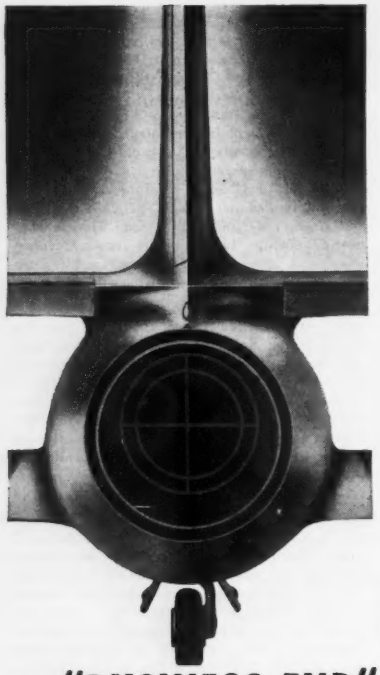
725. Airplane Structures Engineer—B.S. in M.E. from recognized state university. Five years' experience in airplane structural design, major stress analysis and air loading with leading aircraft manufacturers and 3 years of experience with Federal Government agencies having cognizance of aircraft airworthiness. Some teaching experience and author of text on flight loads. Desires position in aeronautical or mechanical engineering or teaching involving structural design, stress analysis, fluid mechanics, or other analytical or research work.

723. Aeronautical Engineer—Young Puerto Rican, 20 years old, American citizen; graduate of Academy of Aeronautics, February, 1947. Speaks and writes Spanish. Will accept position in New York, Puerto Rico, or South America.

722. Research Engineer—Age 29, married. B.S. Ae.E., 1943. M.S. Ae.E. expected in 1947. Three and one-half years' research experience including general aerodynamics and subsonic and supersonic wind-tunnel testing. Supervisory experience.

721. Engineering Writer—B.S. degree in Aeronautical Engineering, Purdue. M.S. in Journalism. Married; 23 years old. Has taught aircraft structures and mathematics. Wants to work with a technical publication as assistant editor or similar post. Although magazine work is preferred, will consider any position that would draw upon engineering and writing training. Would be interested in college teaching.

720. Development or Design Engineer—Twelve years' specialized in power plant installation, design, test, research and proposal work as designer, group engineer and senior project engineer. Also familiar with design, test, and performance calculations of exhaust ejector pumps and thrust augmenters, and some design of ramjet engines. Five years' air-frame design experience and 5 years' diversified shop, tool engineering, and plant engineering work. Since end of war, partner in a small Midwestern engineering company doing some work on airplane component design. Well versed in organizing and follow through of projects and in dealing with personnel. Born, graduated, and 5 years' engine-design experience in Germany. In United States since 1929; citizen since 1935; age 45; married. Desires position with airplane or component manu-



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719. Aeronautical Engineer—B.S. degree in Aeronautical Engineering; graduate work, majoring in physics; age 31. Eight years' aeronautical engineering experience, consisting of 6 years in stress analysis, structural testing, and structural design criteria development and 2 years in preliminary aircraft design. Thoroughly experienced in aerodynamics, aircraft structures, and design. Capable as a project engineer and in the supervision of engineering and laboratory personnel. Desires position requiring initiative and responsibility in which engineering experience and background will be of value.

717. Aeronautical Engineer—M.S. in Ae.E.; A.B. in mathematics. Four years' experience in stress analysis, flutter, and vibration with leading aircraft firms. Interested both in teaching and in industry, preferably in New York area.

716. Pilot—Position wanted as pilot for private concern with sales engineering possibilities. B.S. in Ae.E. Four years' engineering experience with airplane manufacturers. Four and one-half years' air-line experience in twin-engined and four-engined equipment; 2,600 hours' logged time. C.A.A. ratings held—commercial, single- and multiengined land, instrument, and instructor. Free to locate anywhere but Chicago preferred.

715. Instrument Engineer—B.E.E., Cornell University, 1943. Four years' experience with recording and indicating instrumentation in flight test division of leading aeronautical research laboratory. Developed instrumentation and calibration techniques and supervised the installation and maintenance shop personnel. Desires position with aeronautical laboratory or instrument manufacturer.

714. Aeronautical Engineer—B.S., Rensselaer Polytechnic Institute. Age 24. Well experienced in the structural analysis and design development of supersonic military aircraft and missiles. Additional experience and background include aerodynamics major as undergraduate and 3 years in U.S. Navy as aircraft engineering officer-specialist in structures and engine maintenance and repair. Desires permanent position with West Coast aircraft concern. Prefers to continue work in supersonic research and development in either structures or aerodynamics.

713. Manufacturers Representative, Sales, or Field Engineer—Engineer with 17 years' aeronautical design, plus 3 years of successful aircraft sales engineering experience. Has technical, executive, and sales ability. Desires connection with distributors or manufacturers to handle products selling to West Coast aircraft industry. Well known to both engineering and purchasing personnel of California aircraft companies. Available immediately.

712. Materials, Processes, and Standards Engineer—M.E. degree; seeks position with aircraft or metal fabricating plant in New York Metropolitan area or Long Island. Excellent record: nationally known author; prominent welding consultant; authority on materials, processes, and standards; research; design; administration; production; industrial engineering; estimating. Presently employed with one of America's foremost aircraft companies.

711. Professor of Aeronautical Engineering—B.S. in M.E.; M.S. in A.E. Five years' teaching experience as Associate Professor of Aeronautical Engineering, in well-established engineering college. Five years' varied industrial experience, including development work on guided missiles. Desires permanent position in recognized engineering college teaching airplane design and aerodynamics. Primarily interested in research and development of light planes. Available immediately.

710. Aeronautical Engineer—Married; age 30. Four years' experience in structures and static test. Experience in electronic instrumentation and flight test. Desires position with aircraft manufacturer or operator as a design development, test, field, or maintenance engineer. Starting salary and location secondary if opportunities are right. Available immediately.

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mentation for testing. Six months at Wright Field as company representative for static test of large airplane. Two years' experience in structural and mechanical design for high-speed variable density wind tunnel. One year in Navy radar program. Now attending California Institute of Technology. Will obtain M.S. in Aeronautics in June. Would like industrial research or teaching and research with work toward a higher degree.

709. Aeronautical Engineer—B.S. in Ae.E. Experience includes structural testing, drafting, and liaison on both military and commercial aircraft. Seeks position in structural testing or wind-tunnel testing. Location open.

708. Aeronautical Engineer—Financially independent, as the result of successful designs, desires new position on West Coast with sufficient authority or scope to be able to obtain results. Successful projects previously headed, both commercial and military, will be furnished as proof of ability to lead either design or research developments. Salary is of minor importance.

707. Sales Engineer—Engineer with 27 years' experience in aircraft engineering and manufacturing. Has ingenuity and engineering ability combined with sales ability. Desires sales engineering connection in Los Angeles area in any field requiring these characteristics.

705. Aeronautical Engineer—Former pilot; long and broad experience in nearly all phases of airplane design, manufacture, and operation. Lately specializing in gas turbines and hydraulics. Especially interested in development.

704. Aeronautical Engineer—Seventeen years' experience on airplanes and 2 years on helicopters as layout man, group leader on drafting, design draftsman, chief draftsman, project engineer, design engineer, and assistant chief engineer, concerning commercial and military aircraft. College education and 5 years' original experience in mechanical engineering.

703. Aeronautical and Aircraft Maintenance Engineer—B.Ae.E., N.Y.U., 1944. Two and one-half years' overhaul, maintenance, modification, and repair of single- and multiengined aircraft in both military and commercial aviation, plus previous limited association with manufacturing industry. Seeks a responsible engineering position to which adaptable in either manufacturing industry or air transport. Will consider overseas employment.

702. Engine Research Technician and Draftsman—College background; 2 years' aeronautical engineering; 29 years old; married. Nine years of technical and practical experience in aircraft-engine production and development. Thorough familiarization with engine design and development, laboratory testing and research, engineering analysis, and layout and detail drafting. Two and one-half years' experience with gas-turbine and jet propulsion engineering projects at U.S. Navy Air Test Research Center. Desires permanent position with leading engine manufacturer or experimental development unit in research, development, designing, or liaison capacity, preferably in New England or Eastern Coastal area.

701. Mechanical Engineer—Age 30; B.S. and M.S. degrees. Two and one-half years' aircraft-power-plant installation design and development. Three and one-half years' aircraft gas-turbine thermodynamic analysis involving design of turbine and compressor elements and performance evaluation. Both jet and prop-jet experience. Desires responsible position on gas-turbine or allied power-plant work having good growth possibilities. East Coast area preferred.

700. Project Engineer—Age 36. B.S. in M.E., plus some postgraduate work. Nine years' experience in production and development of electromechanical instruments. This work has included considerable time spent with laboratory, manufacturing, and inspection groups and also with customers on related engineering problems. Especially interested in cost-reduction work. A complete outline of experience and qualifications will be sent upon request.

699. Chief Inspector or Experimental Department Head—Twenty years' experience in the aircraft industry, including experimental, quality control, and production analysis. Seeks position as chief inspector or head of experimental department. Location open.

698. Engineer and Executive—Almost 30 years' experience on airplane and accessory design, airport selection and layout, and airplane operations engineering. Good organizer and manager; sound business experience; capable technical writer; wide knowledge of materials and processes.

697. Aircraft Structural Engineer—Graduate engineer, B.S. in M.E., Ae.E. Two years' aircraft structural design and research experience. Design experience gathered with both military and personal aircraft. Thoroughly familiar with C.A.A. requirements and static testing. Structural research experience gathered while in the Army Air Forces. Desires position in structural design or structural research department. Will locate anywhere.

696. Aeronautical Engineer—B.S. in Ae.E., New York University (Guggenheim School of Aeronautics). Almost 2 years' mechanical training and experience in the A.A.F. Six months' experience with small West Coast aircraft company performing design and stress analysis of major components of prototype airplane under supervision of chief engineer. At present, graduate student at M.I.T., specializing in rotary wing aircraft working toward S.M. in Ae.E. Good grades throughout schooling. Desires position with progressive helicopter company. Details and references upon request.

Aeronautical Reviews

(*Continued from page 67*)

Graph for Determining Lug Shear-Out Distance. Wayne A. McGowan. *Product Engineering*, Vol. 18, No. 5, May, 1947, pp. 157, 159, diagrs.

Wind Tunnels and Laboratories

The Effect of Wall Interference upon the Aerodynamic Characteristics of an Airfoil Spanning a Closed-Throat Circular Wind Tunnel. Walter G. Vincenti and Donald J. Graham. *U.S., N.A.C.A., Advance Confidential Report No. 5D21 (Wartime Report No. A-12)*, June, 1945. 66 pp., figs. 18 references.

Tunnel-Wall Corrections to Rolling and Yawing Moments due to Aileron Deflection in Closed Rectangular Wind Tunnels. Donald J. Graham. *U.S., N.A.C.A., Advance Restricted Report No. 4F21 (Wartime Report No. A-14)*, January, 1945. 33 pp., figs. 6 references.

Supersonic Wind Tunnel. *North American Aviation, Inc., Release*, Recd. May 21, 1947. 2 pp., illus.

This small, continuous-flow tunnel can operate at Mach Numbers from 1.25 to 3.25. A complete schlieren optical system is used for visual study of shock wave patterns. An adjustable diffuser permits the highest possible air speed for the pressure being used.

Wind Tunnel Compressor Equipment. *The Engineer*, Vol. 183, No. 4762, May 2, 1947, pp. 376–379, illus.

The R.A.E. high-speed wind tunnel at Farnsborough has an overall length of 130 ft. and a diameter of 37 ft. The working section is 10 ft. by 7 ft. The installation is equipped with two combined compressor evacuators and a pilot compressor evacuator. All three sets are two-crank, two-stage vertical units. The displacement of each of the two main sets is 5,000 cu.ft. per min. when acting as vacuum pumps or as single-stage compressors, and 3,300 cu.ft. per min. when operating as two-stage machines. This assembly can raise the pressure in the tunnel to 60 lbs. per sq.in. or evacuate it to 0.1 atmosphere.

Germany's Giant Wind Tunnel. Alan Pope. *Air Trails and Science Frontiers*, Vol. 28, No. 7, May, 1947, pp. 30, 31, 111, illus.

Description of an uncompleted wind tunnel at St. Otztal, Austria. The air speed in the test section was to be about 750 m.p.h. obtained with two 18-blade counterrotating fans, each 49 ft. in diameter. Some proposed dimensions were: total length of tunnel, 575 ft.; diameter of test section, 26 ft.; and length of test section, 46 ft. The tunnel was expected to supply experimental correction data applicable to other tunnels.

The Merrill-Aerolab Wind Tunnel Balance. *Aerolab Development Co., Release*, April 26, 1947. 4 pp., illus.

A six-component balance. The load limits are in the order of 100 lbs. for lift, 50 lbs. for drag, and 25 in.lbs. for moment It is sensitive to 0.002 lb. and can be read to 0.0005 lb.

Notes on Some German High Speed Aerodynamic and Guided Missile Research. S. H. Hollingdale. *Combined Intelligence Objectives Sub-Committee, Item No. 27, File No. 32-84.* 8 pp. British Information Services, New York. $0.35.

Pre-Test Model of Tunnel Saves Research Time and Money. R. C. Molloy, H. H. Hoadley, and D. H. Brendal. *Aviation*, Vol. 46, No. 5, May, 1947, pp. 57–59, illus.

The United Aircraft Corporation's wind tunnel is of the return-flow type and is intended for aerodynamic research and power-plant testing. An 18-ft., 200-m.p.h. test section can be interchanged with an 8-ft., 600-m.p.h. section. An outdoor test stand is provided for ground testing of power plants. The high-speed propeller test unit has an 8-ft. throat. Preliminary testing of a $^1/_{12}$-scale replica permitted refinement of the design of the fan blades, the diffusers, the air exchanger, and the configuration of the test sections.

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